M2540-92000-sm-03
November 2003

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About This Manual

Audience

This manual supports the field service installation, maintenance, and repair of the Philips M2540A Ultrasound Systems. The user of this document is a qualified ultrasound electronics technician who has completed training classes on the system and its peripherals.

Manual Format

This manual is in Portable Document Format (PDF), for viewing on a laptop computer with Adobe Reader. A list of bookmarks functions as an additional table of contents. Those bookmarks, the table of contents, and cross-references use hypertext links to provide access to the referenced information.

Conventions in This Manual

The following conventions are used in this manual:

- Hypertext links are blue.
- All procedures are numbered. You must complete steps in the sequence they are presented to ensure reliable results.
- Bulleted lists indicate general information about a function or procedure. They do not imply a sequential procedure.
- Control names and menu items or titles are spelled as they are on the system, and they appear in bold text.
- Symbols appear as they appear on the system.
- An English system is assumed.

Service Manual Questions or Comments

If you have questions about the service manual, or you discover an error in the manual, contact Philips Ultrasound Technical Publications:

- bothell.techpubs@philips.com
- Technical Publications, MS 964, at the address below

Customer Assistance

Various support locations around the world can provide customers technical assistance with the ultrasound system. Customers should contact the representative or sales office from which they purchased the system or the nearest Philips Ultrasound office.

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1 General Information

This section includes the following sections:

- "Product Overview" on page 16
- "System Description" on page 17
- "Optional Peripherals (VCR, Printers, and Image Devices)" on page 21
- "Preset Functions" on page 21
- "Keyboard Equivalencies" on page 22
- "Safety Specifications" on page 23

Product Overview

The Philips M2540A ultrasound system includes a cart, a system control panel, and a monitor. A foot pedal on each caster locks and unlocks the front cart wheels. All four wheels swivel. The system control panel and the monitor adjust up and down and swivel as a unit, and the monitor tilts and swivels on its mount.

The cart's lower enclosure contains the M2540A's computer, disk drives, and ultrasound generating and processing boards.

CD-RW and floppy disk drives are standard equipment.

Optional peripheral components include a video cassette recorder, various types of printers, a foot switch, and a magneto-optical disk (MOD) drive. The VCR is available in either NTSC or PAL configuration. For a complete list of optional components, see "Optional Peripherals" on page 251.

Most peripheral devices mount on top of the lower enclosure. The optional plain paper printer is not mounted on or powered by the system, but is connected from a remote location.

The Resident Self Test (RST) software verifies system performance and helps diagnose problems.

The system control panel includes four numbered option buttons whose functions are assigned by the customer. For details on configuring these controls, see the Philips EnVisor Series Help.

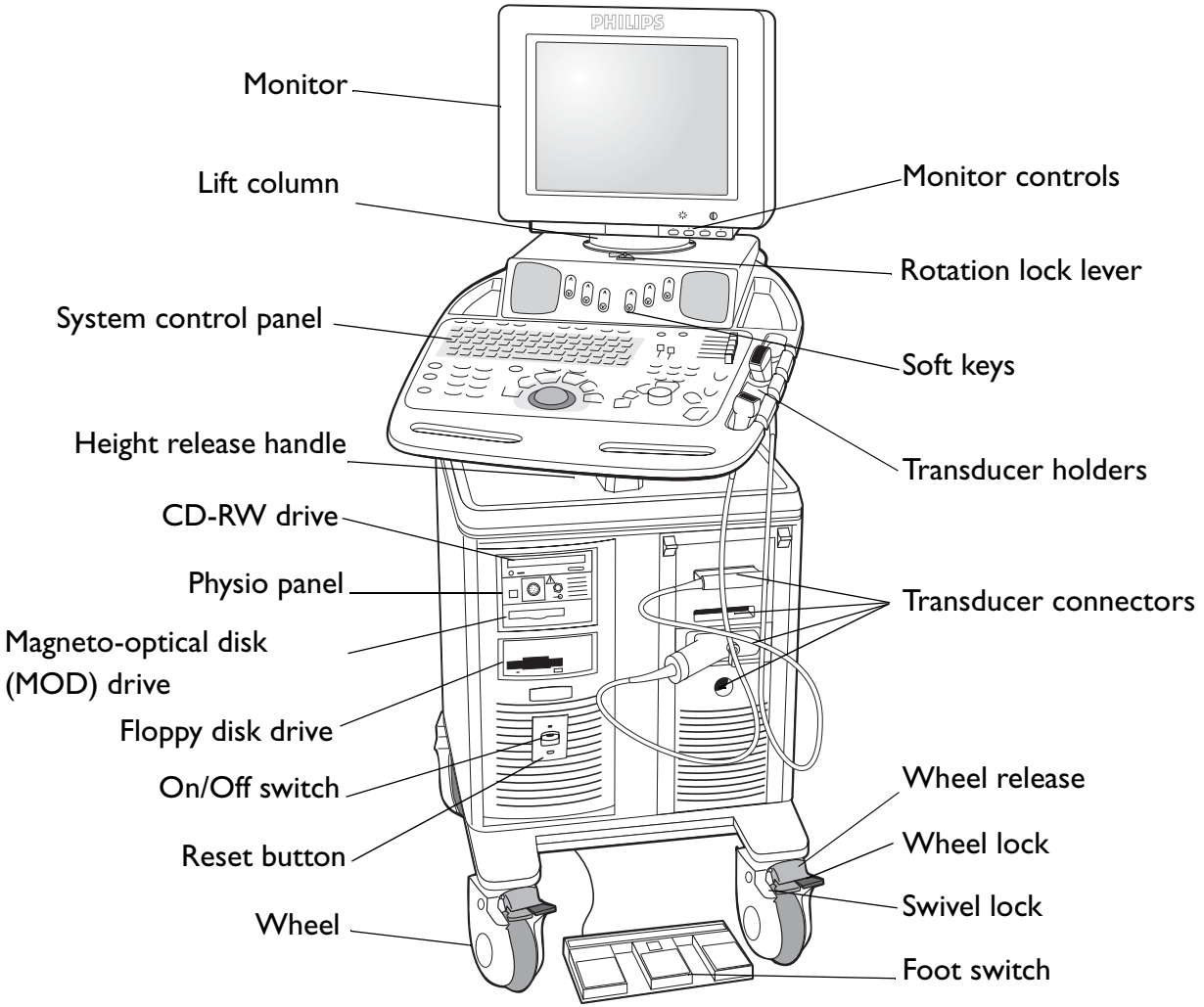
System Description

Major ultrasound system components are described on the following pages. These descriptions include important features of the cart, monitor, system control panel, Physio module, e-box, PC, and system power supply.

References to the left and the right sides of the system are as viewed from the front of the cart.

Figure 1-1 shows the M540A system components.

Figure 1-1 M2540A System Components



Cart

The cart supports the system and acts as the chassis into which all system components are installed and interconnected.

A height adjustment lets you adjust the system control panel and monitor for operator comfort.

An input/output (I/O) panel at the rear of the cart contains three connectors for communication between the system and a network, and for controlling certain legacy printers. The foot switch port, an equipotential lug, and the system ground lug are also on the I/O panel. The panel is at the center of the lower part of the cart, and is accessible to the system operator. For more information about the I/O panel, see "I/O Panel" on page 54.

Cart Wheels (Caster Assemblies)

Four wheels at the cart base provide system maneuverability and braking. All four wheels swivel, and the front wheels can be fixed straight and locked. Foot pedals on the two front wheels lock and unlock the front wheels to prevent the cart from rolling. Locking the wheels immobilizes the system during patient procedures.

PC

The M2540A uses a personal computer (PC) as a central processor. The PC houses several components as standard equipment. These include the acoustic processor input/output (APIO) board, a video card, a CD-RW drive, and a floppy disk drive.

The optional Physio module installs in one of the PC's front drive bays. An optional MOD drive can also be installed in one of the drive bays. The VCR option includes three boards that reside in the PC's PCI slots, and a VCR that mounts on the cart.

For more detailed information about the PC and its components, see "Internal PC" on page 48.

System Monitor

The monitor at the top of the cart is a 15-inch color display mounted on a "twivel" assembly. The twivel allows tilt and swivel positioning of the display for ease of viewing.

E-box

The e-box houses the scanner circuit boards, and is accessible by opening the door at the right rear of the cart.

There are several circuit boards in the e-box:

- Two transmit and receive (TR) boards
- A beam processor/acoustic processor (BPAP) board
- A demodulator board
- The system motherboard
- The distribution board

System Control Panel

The system control panel at the top front of the cart is a replaceable, self-contained module. See "Replacing the System Control Panel" on page 204. The panel interfaces with the imaging system through a USB cable that connects to the internal PC. The USB cable provides power for the trackball, the Enter and Select keys, and the QWERTY keyboard. All the other control-panel functions are powered by a cable from the system power supply.

The system control panel contains a backlit alphanumeric keyboard, slide controls, rotary controls, hard-coded and software-driven keys, and a trackball.

Physio Module

The optional Physio module (see "Physio Module Option" on page 52) installs in one of the PC drive bays. The front panel of the module bears two input connectors:

- A 3-lead electrocardiogram (ECG) physio connector
- An auxiliary analog input (standard ¼-inch phone jack)

An externally generated auxiliary analog input signal using the phone jack can substitute for the 3-lead ECG physio connector at the front panel. You can also input an auxiliary ECG waveform from an external patient monitor and display it in all modes. The R-wave from this signal can serve as a time reference for the system.

Power Supply

The power supply is an enclosed, self-contained, replaceable module that mounts under the e-box at the right side of the cart. It accepts AC input sources from 100 V to 240 V, at 50 Hz or 60 Hz.

The power supply provides all required AC and DC voltages to the system. Three switched 120-VAC outlets for powering the monitor and two peripheral devices are at the rear of the power supply. An unswitched outlet powers the M2540A's internal PC. When the system is shut down, only the 120-VAC outlet to the PC is enabled. A green LED on the left front of the power supply lights when the power supply is energized.

Optional Peripherals (VCR, Printers, and Image Devices)

The M2540A supports several types of optional peripheral devices:

- VCRs, including NTSC-format and PAL-format models
- Thermal color and thermal black and white printers
- Various biopsy kits (See "Supplies and Accessories" on page 252.)
- A MOD drive for data storage

"Optional Peripherals" on page 251 lists all peripherals supported by the ultrasound system. Some peripherals mount on a shelf below the system control panel.

Preset Functions

The ultrasound system includes programmable *presets* that configure the system for best imaging results in a particular situation. Activating a preset initializes system settings to values that are optimal for a chosen exam. The factory-installed software includes several presets, tailored to different applications. The user can define as many as 20 additional presets in each of 8 exam types, to adjust system variables (including acoustic power) to any required configuration.

For specific information regarding the configuration and use of presets or other features of the system, see the *Philips EnVisor Series Help*.

NOTE Backing up presets to a floppy disk safeguards them and preserves the operator's preferred configurations. If preset configurations are subsequently changed, they can be quickly restored from the backup copy, without having to reset them manually. Keeping a backup copy also eliminates the need to manually reconfigure the presets after a software upgrade. For the procedures to back up and restore presets, see "Creating a Backup Floppy" on page 184.

Keyboard Equivalencies

Some of the keys found on a standard PC keyboard are not present on the M2540A. Many of the functions performed by those keys are mapped to keys that are present on the M2540A keyboard. The M2540A keys act as PC-equivalent keys whenever the ultrasound application is not running. Table 1-1 lists the missing PC keys and their equivalents on the M2540A:.

Table 1-1 Keyboard Equivalents

PC Key	M2540A Key	PC Key	M2540A Key
F1	Patient	F9	Option 1
F2	Preset	F10	Option 2
F3	Review	F11	Option 3
F4	Report	F12	Probe
F5	Setup	Esc	THI (Hx)
F6	Help	Delete	Fusion
F7	VCR	Page Up	Left
F8	Mic	Page Down	Right

Safety Specifications

Table 1-2 lists the safety specifications of the M2540A.

Safety Limits

Table 1-2 Safety Limits

Parameter	Specification
Power supply	Complies with IEC60601-1.
Ground wire leakage	See Section 6, "Performance Tests", and the *Philips EnVisor Series Safety and Standards Guide* shipped with the M2540A.
System tip over	Will not tip over on an incline of up to 10 degrees under normal use.
Wheel locks	With wheel locks engaged, system remains stationary on slopes of up to 5 degrees in any orientation.
System surface temperature	System surfaces do not exceed temperature limits specified in IEC 60601-1 and EN 60601-1.
Potentially hazardous components	The power supply and monitor comply with UL 2601-1 1997.
External sharp edges	The system exterior has no sharp edges, in compliance with IEC 60601-1 and EN 60601-1.

Regulatory Compliance

For information about applicable safety standards and specifications, see the *Philips EnVisor Series Safety and Standards Guide* shipped with the M2540A.

2 Specifications

This section lists the specifications of the M2540A ultrasound system. The following specification types are included in this section:

- "Physical Dimensions" on page 25
- "Electrical Specifications" on page 30
- "Monitor Specifications" on page 30
- "Connection and Communication Specifications" on page 31
- "Physio Port Specifications" on page 33
- "Audio/Video Specifications" on page 34

For transducer specifications, see Section 14, "Transducers."

Physical Dimensions

The tables and figuress that follow detail the physical specifications of the M2540A.

Table 2-1 lists the physical specifications of the M2540A and provides a reerence to the figures.

Table 2-1 Physical Specifications

Parameter	Specification	Reference
Dimensions		
Depth (front to back)	103 cm (40.5 in)	See Figure 2-2
Width	53.5 cm (21 in)	See Figure 2-1
Height (to monitor top)	Lowest position: 129.5 cm (51 in) Highest position: 147.5 cm (58 in)	See Figure 2-1
Height of lower enclosure	76.2 cm (30 in)	See Figure 2-2
Monitor to control panel front edge	43.18 cm (17 in)	See Figure 2-2
Monitor depth (front to back)	41.71 cm (16.42 in)	See Figure 2-2
Weight	Less than 91 kg (200 lbs) including display but no peripherals	See Figure 2-2
Environmental	Operational Temperature range: –20°C to 60°C Relative humidity: 20% to 80% Atmospheric pressure: 572 hPa to 1013 hPa (VCR and printers temperature limit: 0°C to 40°C at 80% RH)	
	Storage Temperature range: –40°C to 55°C Relative humidity: 20% to 90%, non-condensing Atmospheric pressure: 572 hPa to 1013 hPa	

Figure 2-1 System Front Dimensions

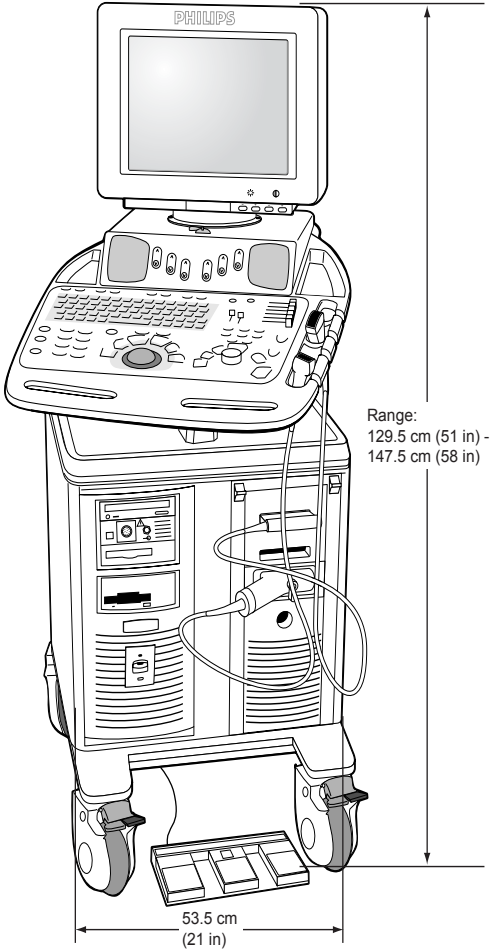


Figure 2-2 System Side Dimensions

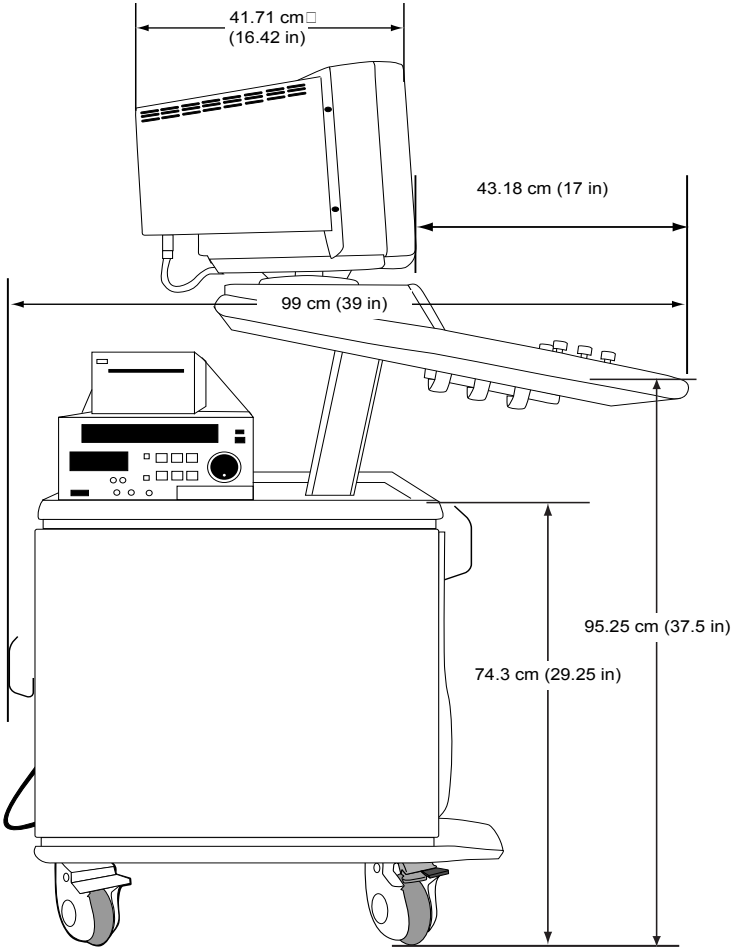


Figure 2-3 System Rear Dimensions

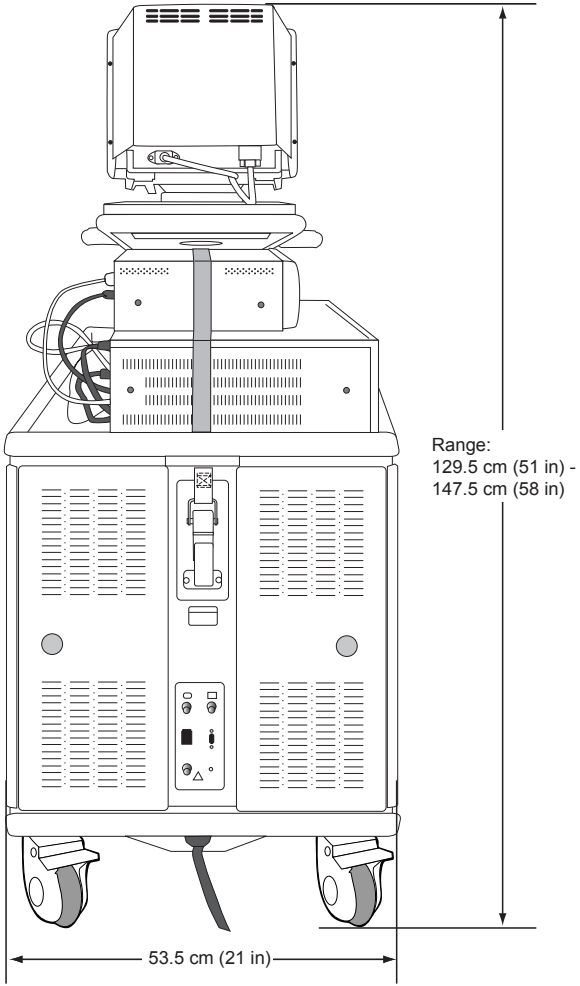
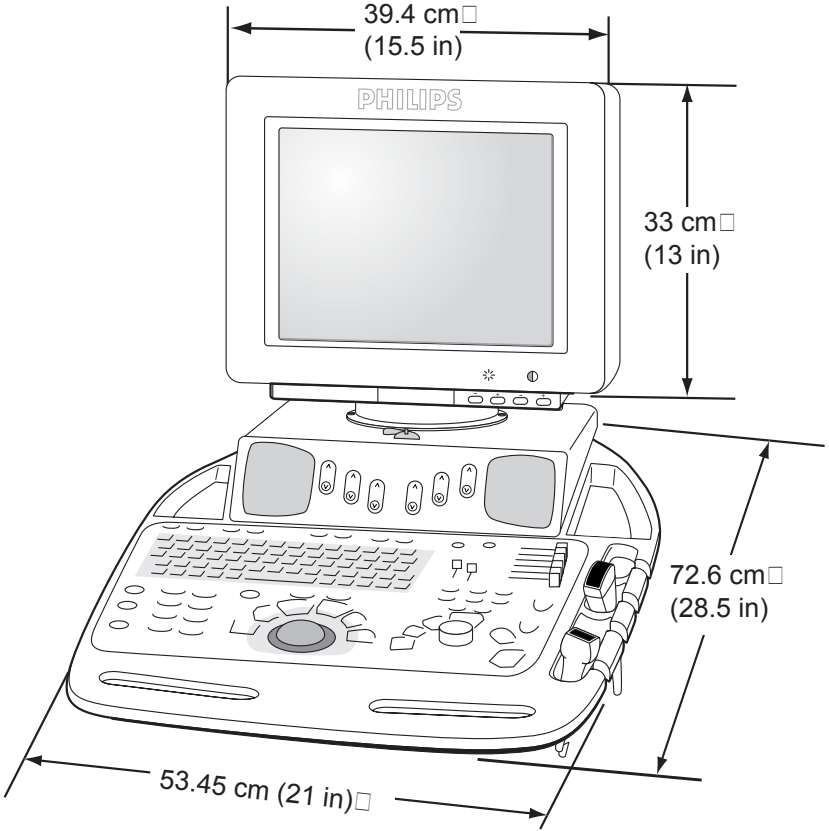


Figure 2-4 System Top Dimensions



Electrical Specifications

Table 2-2 lists the M2540A electrical specifications.

Table 2-2 Electrical Specifications

Parameter	Specification
AC input	90 VAC to 264 VAC, 47 Hz to 63 Hz
Ground impedance	200 milliohm maximum
Dielectric withstand	1500 VAC mains to safety ground 2000 V mains to AC secondaries 4000 V mains to DC secondaries
Load	1150 VA maximum.
AC output (including PC)	120 VAC, 60 Hz, quasi square-wave, 500 VA maximum

Monitor Specifications

Table 2-3 llists the M2540A monitor specifications.

Table 2-3 Monitor

Parameter	Specification
Screen size	15-inch diagonal
Display format	VGA, 800 x 600 75 Hz refresh rate RGB color display
Features	Tilt ±30 degrees Swivel ±135 degrees

Connection and Communi-cation Specifications

Table 2-4 and Table 2-5 list the connection and communicationspecifications of the M2540A.

System I/O Ports

PC Ports

Table 2-4 lists the ports on the rear of the internal PC and describes their locations.

Table 2-4 PC Ports

Port	Specification
Composite video output	Female phono (RCA) on SVGA to TV video card
S-Video output	4-pin mini circular DIN on SVGA to TV video card
S-Video input	4-pin mini circular DIN on video capture card
Print trigger output	3.5-mm phone jack on APIO board
VCR audio output (line out)	Green 3.5-mm stereo phone jack on sound card
VCR audio input (line in)	Blue 3.5-mm stereo phone jack on sound card
Microphone	Pink 3.5-mm stereo phone jack
Speakers	Green 3.5-mm stereo phone jack to system speaker amplifier
Monitor	15-pin D connector on graphics adapter board
Foot switch	9-pin female D-sub connector on the APIO board that carries foot switch signals from the external I/O panel
Com 1	9-pin D connector, RS-232; serial port used to control VCRs
Token ring	50-pin connector on the APIO board

Table 2-4 PC Ports (Continued)

Port	Specification
LAN	RJ-45 to I/O panel for network communication
USB	USB (A) for data and power to system control panel
USB	For black-and-white thermal printer
USB	For color printer
USB	For remote plain paper printer
PS-2 keyboard	DIN circular connector, not used
PS-2 mouse	DIN circular connector, not used
Parallel port	Not used
Serial port COM 2	9-pin D connector, RS-232; serial port used to interface to offline OB analysis stations
Audio input on main board	Not used
Audio line output on PC motherboard I/O	For speaker audio (to power amp in system control panel)

I/O Panel Ports

Table 2-5 lists the ports on the I/O panel and the signals they carry.

Table 2-5 I/O Panel Ports

Port	Connector	Signal
Composite video	BNC	Composite video signal from SVGA to TV video card
Foot switch	D-sub 9	Control signal from foot switch to APIO board Defaults are: record, freeze, and record 2 Each signal is a contact closure to ground, active low, and TTL compatible
Print	BNC	Trigger signal from APIO board
LAN	RJ-45	Communication with local area network

Physio Port Specifications

Table 2-6 lists the specifications of the M2540A's physio ports.

Table 2-6 Physio Port Specifications

Port	Specification
ECG	3 patient leads with R-wave detection Monitoring quality only Frequency response: 1 ±0.5 to 30 Hz ±6 Hz Sensitivity: 3 mV p-p ±2.5 mV for full scale at 100% gain
Aux 1	3-dB bandwidth: full scale DC to 100 Hz minimum Maximum input signal: ±4 V Sensitivity: 2.5 ±0.5 V p-p for full scale at 100% gain

Audio/Video Specifications

The following tables list the audio and video specifications of the M2540A.

Audio

Table 2-7 Audio Specifications

Description	Specification
Speakers	Stereo—VCR, Doppler Doppler spectrum toward transducer—left speaker Doppler spectrum away from transducer—right speaker Maximum power input: 4 watts Impedance: 4 ohms
Frequency Response	130 Hz to 12 KHz
Microphone	Faces front. 10 Hz to 20 KHz electret type

External Video

Table 2-8 External Video Specifications

Description	Specification
Composite video	NTSC 3.58 (USA), PAL 4.43 (Europe) 1.0 V p-p ±5% into 75 ohms
Print	Trigger 1 signal from the APIO board Active low: ON = 0.5 V max @ 1 mA; OFF = 5.25 VDC maximum voltage

Video Output Specifications

Table 2-9 Video Output Specifications

Output	Specification
VGA to system monitor	0.7 V p-p RGB with TTL sync
S-Video Output to VCR	1.0 V p-p luminance incorporating sync and 0.3 Vpp chrominance as shown in Table 2-8. This timing is essentially RS-170 (60 Hz) or CCIR (50 Hz) video timing.

3 Safety

This section provides an overview of safety considerations for the ultrasound system. These safety concerns apply to patients, operators, and service engineers. For more detailed safety information, see the *Philips EnVisor Series Safety and Standards Guide*.

The following topics are included in this section:

- "Transmit Power (Acoustic)" on page 37
- "Acoustic Exposure" on page 37
- "AIUM/NEMA Output Display Standard" on page 38
- "Explosive Hazards" on page 40
- "Electrical Warnings" on page 41
- "Peripheral Connections" on page 41
- "Glutaraldehyde Exposure" on page 41
- "Moving the System" on page 42
- "Electromagnetic Compatibility" on page 45
- "Restrictions for Use" on page 45
- "ESUs" on page 46

Transmit Power (Acoustic)

Acoustic output, expressed as an index, is displayed on the screen to allow the best possible diagnostic image with minimal power output. A display standard presents this index using one of the following four power indices:

- Mechanical index (MI)
- Thermal index for soft tissue (TIS)
- Thermal index for bone (TIB)
- Thermal index for cranial bone (TIC)

The index setting on the **System Setup** menu selects the power index used. The displayed index is based on this setting and on preset configuration and imaging mode.

NOTE The power index setting on the **System Setup** menu selects any of the four power indices for display at any time.

For additional information on acoustic power settings and the power index, see the *Output Display Standards and ODS Acoustic Tables, Philips EnVisor/EnVisor HD Phased Array Imaging System* (M2540-96605-01).

Acoustic Exposure

Although no harmful effects have been demonstrated for any of the ultrasound frequencies, intensities, and exposure times used in examinations with Philips ultrasound systems, Philips recommends that you consider the following, and use the lowest ultrasound exposure that produces diagnostically acceptable information:

- Use diagnostic ultrasound only when there is a good medical reason.
- Reset the controls at the start of every examination.
- Reduce exposure time, independent of acoustic index value.
- Use techniques that let you collect clinical data quickly and end the examination promptly.

- Select a transducer that provides good resolution and focal depth for the region of interest. Then use the imaging controls to fine-tune image resolution.

For more detailed information on acoustic exposure, see the *Output Display Standards and ODS Acoustic Tables, Philips EnVisor/EnVisor HD Phased Array Imaging System* (M2540-96605-01).

AIUM/NEMA Output Display Standard

In compliance with the Output Display Standard (ODS) jointly proposed by the American Institute of Ultrasound in Medicine and the National Electrical Manufacturers Association, the Philips ultrasound system displays power output indices related to the potential for bioeffects.

Real-time information related to the power output is displayed on the monitor, indicating the type of index displayed and the value of that index for the acoustic output currently being used. For example, if the output corresponds to a mechanical index of 0.8, the following is displayed:

MI: 0.8

The displayed index is one of four types: MI, TIS, TIB, or TIC. These ultrasound abbreviations conform to the AIUM/NEMA Output Display Standard.

Soft tissue thermal index (TIS) is used in cardiac, fetal, and abdominal scanning.

The thermal index for bone (TIB) is used in applications such as second or third trimester fetal scanning and neonatal cephalic (through the fontanelle) scanning.

The cranial bone thermal index (TIC) is used for transcranial imaging.

NOTE The power index displayed on the screen depends on the preset type, the active transducer type, the imaging mode, and the selected power index. Any of the four power indices is selectable for display at any time, using the power index setting in the **System Setup** menu.

Automatic Index Selection

For automatic selection of a power index based on system mode, the user selects the power index setting of **Normal** from the **System Setup** menu. This directs the system to choose an index based on the active preset and imaging mode.

When MI Is Displayed with the Normal Setting

MI is displayed if any of the following conditions exist:

- 2D Only is the active imaging mode.
- Black and White MMode Preview is the active imaging mode.
- Black and White Doppler Preview is the active imaging mode.
- Black and White Doppler 2D Live is the active imaging mode.

When TIS Is Displayed with the Normal Setting

If none of the conditions in "When MI Is Displayed with the Normal Setting" on page 39 exist, if no transcranial preset is active, and if any of the following conditions exist, TIS displays:

- Color is turned on.
- Angio is turned on.
- MMode Trace is the active imaging mode.
- Doppler Spectral is the active imaging mode (with 2D Live off).

When TIC Is Displayed with Normal Setting

If none of the conditions in "When MI Is Displayed with the Normal Setting" on page 39 exist, if a transcranial preset is active, and any if of the following conditions exist, TIS displays:

- Color is turned on.
- Angio is turned on.

- MMode Trace is the active imaging mode.
- Doppler Spectral is the active imaging mode (with 2D Live off).

If the user selects an ODS setting other than Normal, the selected index type is used as the preferred acoustic power display format, regardless of the mode, the transducer, or the preset that is selected.

The displayed index value does not provide an exact value of the potential for adverse bioeffects in the patient. However, for any patient, the higher the value, the higher the potential for adverse bioeffects. The user can minimize the potential for bioeffects by keeping the index value as low as possible, by choosing the right transducer and making adjustments. Minimizing examination time also minimizes bioeffects.

WARNING

The ODS power index formulas were defined for reasonable worst case patient conditions. It is likely that a particular patient's actual conditions are better than indicated by the index. The operator should be aware of patient conditions that mitigate the actual exposure.

Explosive Hazards

Observe the following practices to avoid explosive hazards:

- Do not operate the system in the presence of flammable anesthetics.
- When using the imaging system in the operating room, do not switch system power on or off. Be sure system power is on before the operation starts, and leave it on for the duration of the procedure.

WARNING

Do not use the foot switch in the operating room.

Electrical Warnings

Observe the following precautions to prevent electric shock:

- Only qualified service personnel should remove system covers (trim and service panels). Accidental contact with electrical circuits inside the system could cause serious injury.
- Use only the power cords supplied with the system, and connect them only to properly grounded electrical outlets.

WARNINGS

- Failure to follow these warnings can affect both patient and operator safety.
- Do not connect the ultrasound system to the same circuit used for life-support devices.

Peripheral Connections

Peripherals (such as a VCR or a printer) typically meet general electrical safety usage requirements, but do not meet medical device standards. Therefore, do not use system peripherals within 6 feet of a patient unless the peripherals receive power from an isolated power outlet on the imaging system, or from an isolation transformer that meets medical safety standards. The 120 VAC outlets on the power supply are isolated. The specific peripherals listed in "Optional Peripherals" on page 251 meet medical device standards when installed in the system as recommended.

Glutaral-dehyde Exposure

The United States Occupational Safety and Health Administration (OSHA) has issued a regulation dealing with levels of acceptable glutaraldehyde exposure in the working environment. Philips does not sell glutaraldehyde-based disinfectants with its products. However, this type of disinfectant is recommended for disinfection of transesophageal (TEE) or endocavity transducers.

To minimize exposure to glutaraldehyde fumes, make sure the area is well ventilated and use appropriate eye and skin protection.

Moving the System

Although the system is designed to be mobile, remember that it is *very heavy*, and that you must take precautions when moving the system.

The ultrasound system has been designed to be as lightweight and mobile as possible. However, the system weight—including the weight of the monitor, a printer, and a VCR—is approximately 100 kg (220 lb). Because of this weight, you must use caution when moving the system, since the ability to move any ultrasound machine is directly related to an individual's size and strength.

Some sonographers, particularly those weighing less than 45.4 kg (100 lb), have stated that they injured their backs moving similar systems. These complaints could not be directly tied to one particular incident. They do, however, point out the need to be careful in transporting medical equipment such as an ultrasound system.

Before Moving the System

To move the system, take the precautions listed in the following sections, and do the following:

- Before moving the system, be sure to remove any loose equipment from the top of the system, disconnect the system power cord, and disconnect all external devices.
- Before transporting the system in a vehicle, remove the monitor and all transducers from the system and put them in a packing box.

When Moving the System

This system is equipped with a front handle and brakes on the front wheels.

Always use the handle at the front of the cart to move the system from place to place.

WARNING

Never strap or secure the system at any point above the peripheral tray.

NOTE Use caution and follow these steps when moving the system from patient to patient.

To move the system:

1. Ensure the system is unplugged.
2. Unlock the wheel locks before moving the system.
3. Make sure the control top is locked, to prevent its pivoting during transport.
4. Engage the track locks on the front wheels to ease straight-line travel.
5. Push with the handle at the front of the cart.
6. After the system is in position, engage the wheel locks to immobilize the system, and unlock the control top to allow it to pivot.

Moving on Ramps or Uneven Surfaces

Do not move the system over uneven elevator entrances by lifting the machine or any part of the machine.

Always use two people when moving the ultrasound system up and down ramps longer than 20 feet or steeper than 5 degrees. (Wheelchair ramps are usually less than 5 degrees.) Avoid ramps that are steeper than 10 degrees, to eliminate the danger of the system tipping over.

System Tilting

The system has been tested for stability using the IEC 60601-1 test protocol. Following this protocol, the system will not tip over on an incline of up to 10 degrees in any direction. When this amount of incline is exceeded, there is a potential for the system to tip over.

WARNING

Use care when tilting the system for an incline. The amount of incline allowable to prevent tip-over is 10 degrees. Moving the system over a roadside curb or other small but steep incline can cause the system to exceed 10 degrees of incline.

Transporting the System in a Vehicle

Always engage the wheel locks while transporting the system in a vehicle, and use restraining straps to secure the system in place. Do not rely on the wheel locks to hold the system on inclines greater than 5 degrees.

Be sure that the transporting vehicle can handle the weight of the system (or systems) plus the passengers.

Be sure the load capacity of the loading lift can accommodate the weight of the ultrasound system. A minimum capacity of 249.5 kg (550 lb) is recommended.

Always secure the ultrasound system while it is on the loading lift so that it cannot roll. Make sure the control top is locked, to prevent its pivoting. Engage the wheel locks and use wood chocks, restraining straps, or other similar types of constraints as an added safety measure. Do not attempt to hold the system in place manually.

WARNING

Never strap or secure the system at any point on the control top or monitor.

Load and unload the ultrasound system while the transporting vehicle is parked on a level surface. The system's weight can easily cause it to roll on any incline.

The system's weight on an extended loading lift may cause the transporting vehicle to tilt, which could cause personal injury or system damage.

WARNING Never ride on a loading lift with the system. Your weight combined with the system's weight can exceed the lift's load capacity.

Be sure the ultrasound system is firmly secured while inside the transporting vehicle. Any movement, combined with the system's weight, could cause the system to break loose.

NOTE If you use the ultrasound system in a mobile van, follow the same fundamental transporting precautions listed in the preceding sections.

Electromagnetic Compatibility

This system has been tested for electromagnetic compatibility (EMC) according to the international standard for EMC with medical devices, as determined by the International Electrotechnical Commission (IEC 60601-1-2). This IEC standard has been adopted in Europe as the European Norm EN 60601-1-2.

Avoiding EMI

Medical devices can generate or receive electromagnetic interference (EMI). The EMC standards describe tests for both emitted and received interference. Emission tests deal with interference generated by the device being tested. The Philips ultrasound system does not generate interference based on the tests described in the standards.

Ultrasound systems are designed to receive radio frequency (RF) energy and are therefore susceptible to EMI generated by other RF energy sources. Examples of other sources of EMI are medical devices, information technology products, and radio and television transmission towers. Tracing the source of radiated interference can be a difficult task.

To identify sources of EMI, see "EMI" on page 176.

Only a physician can determine if an artifact caused by radiated interference has a negative impact on image quality and the subsequent diagnosis.

Restrictions for Use

The M2540A ultrasound system is subject to certain restrictions that are described in the following sections.

Immunity Level Test Results

The EMC standards require that manufacturers of patient-coupled equipment specify electrostatic discharge immunity levels for their systems. This type of device is designed to receive and amplify low-level signals in the same bandwidth as the interference to which it is susceptible.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance. Degradation in image quality is a qualitative assessment that can be subjective. The simplest way to assess degradation is to note when the first sign of an artifact is seen. This method has two advantages: It removes the issue of subjective decision-making and provides the most stringent test results.

Caution should therefore be taken in comparing immunity levels of different ultrasound systems. The criteria used for measuring degradation are not specified by the standard, and can vary with the manufacturer.

Philips has tested each class of transducer for every operating mode over a wide range of frequencies. This testing showed PW Doppler to be the most susceptible to RF interference.

For additional information about compliance with EMC standards, see the *Philips EnVisor Series Safety and Standards Guide* shipped with your system.

Electrostatic Discharge

Electrostatic discharges can cause the ECG heart rate display to increase by 10 to 15% for a few seconds after the discharge. However, the ECG heart rate display returns to normal within 4 seconds.

ESUs

Electrosurgical units (ESUs) and other devices intentionally introduce RF electromagnetic fields or currents into patients. Because imaging ultrasound frequencies are also in the RF range,

ultrasound transducer circuits are susceptible to RF interference. While an ESU is in use, the noise generated severely interferes with the black and white image and completely obliterates the color image.

4 Theory of Operation

Overview

This section provides a technical overview of system functions. The discussion focuses on the main functions and features of the system's PC, circuit boards, and power distribution. Main system functions are also shown in the functional block diagrams at the end of this section.

The M2540A's internal PC replaces the back-end electronics used in earlier ultrasound systems to handle display processing. The beam processor/acoustic processor (BPAP) board handles the acoustic and beam processing front-end functions.

This section covers the following areas of the system:

- "Internal PC" on page 48
- "TR Boards" on page 49
- "BPAP Board" on page 51
- "Demodulator Board" on page 52
- "APIO Board" on page 52
- "Physio Module Option" on page 52
- "System Motherboard" on page 53
- "Distribution Board and Connector Modules" on page 53
- "I/O Panel" on page 54
- "System Control Panel" on page 54
- "Power Supply" on page 55
- "Functional Block Diagrams" on page 56
- "Transducer Safety Testing: Test Setup and Theory" on page 62

Internal PC

The M2540A uses an internal PC to coordinate and perform many of the functions that required dedicated circuit boards in earlier ultrasound systems. The power button on the front of the PC is the system power switch. Turning on the PC starts the ultrasound system.

Standard PC Components

The M2540A's internal PC contains the following standard components:

- A motherboard
- A hard drive
- A graphics card in the AGP slot
- The Acoustic Processor I/O (APIO) board, in a PCI slot (See "APIO Board" on page 52)
- A 3.5-inch floppy disk drive
- A CD-RW drive
- CPU temperature monitoring

PC Ports

The PC motherboard's ports are used as follows:

- A USB port communicates with the system control panel
- A USB port communicates with an optional black and white thermal printer
- A USB port communicates with an optional color printer
- A USB port communicates with an optional plain paper printer
- An internal USB port communicates with the optional Physio module
- A LAN port connects the PC to a network
- A 3.5-mm phono jack receives audio signals from a microphone
- A 3.5-mm phono jack supplies the signal that drives the system's speakers
- An RS-232 port (Com 1) controls an optional VCR
- An additional RS-232 (Com 2) port is used for report data export

VCR-Related Components in the PC

The optional VCR requires several cards inside the PC and an adapter that connects to the SVGA output of the PC's graphics adapter board. For a detailed block diagram, see Figure 4-2 on page 58.

The following are the VCR-related components; all reside in the PC PCI slots:

- A sound card that receives audio from the VCR, and supplies sound to the VCR
- A video capture board that receives S-Video signals from the VCR
- An SVGA-to-S-Video card that converts the SVGA signal from the graphics adapter board (in the AGP slot) to S-Video for the VCR, and composite video to the rear I/O panel
- An SVGA adapter that connects the graphics adapter board to the SVGA-to-TV video card and to the monitor

Optional Drive-Bay Components

The PC's drive bays accept the following components:

- The Physio module that provides ECG monitoring capability. The drive bay's power connector powers the module. The module communicates with the ultrasound system through a USB cable to the PC motherboard. For detailed information on the Physio module, see "Physio Module Option" on page 52 and Figure 4-4 on page 61.
- The MOD drive allows archiving of images, studies, and reports on removable disks. The MOD uses the drive bay's power port and communicates with the ultrasound system with an IDE cable.

TR Boards

The M2540A's e-box contains two transmit and receive (TR) boards. Each has a connector that plugs into the motherboard and another connector that passes through the motherboard and plugs into the distribution board. The two boards form electronic beams of the transmit and

receive signals. Each TR board contains 64 transmitters and 32 preamps multiplexed into 64 receive channels. This allows multiplexing the system's 64 active channels into 128 element arrays. Each receive channel consists of time gain compensation (TGC) amplifiers, low-pass filters, 10-bit analog- to-digital (A/D) converters, and one-eighth of a digital beam-forming circuit. Each TR board sends on its output bus a value that is the sum of the data from its 32 channels plus its 18-bit input bus. The last TR board in this chain outputs the final summed RF data to the demodulator board.

The transmit and receive beam-forming coefficients for acoustic lines are downloaded on the coefficient bus from the BPAP board.

The BPAP board generates the timing to start and stop each firing line, and sends the transmit signal to the TR board, through the distribution board and the connector modules to the transducer. Analog drivers generate the transmitted RF data. A digital timing generator delays and times each of the analog drivers. The delay generators receive the appropriate delay values from the BPAP for each channel. The system power supply controls the amplitude of the transmitted waveform.

The received signal is preamplified, TGC amplified, low-pass filtered, and digitized (in all modes except CW). The BPAP board generates TGC control signals through the demodulator board.

After being digitized, the signal on each line is delayed appropriately. The outputs of all channels are daisy-chained together to sum the outputs. The RF data output of one TR board is the input to the next TR board, and the outputs of the TR boards are summed to form the received beam. The summed output signal (RF DATA) goes to the demodulator board.

The CW Doppler signal is mixed to an analog intermediate frequency (IF) signal. The CW Doppler output is a single differential signal routed to the demodulator board.

BPAP Board

The beam processor/acoustic processor (BPAP) board contains two processors. One of them controls beam-forming, line-to-line operation. The other handles the processing of scan conversion, color flow, and Doppler signals.

The BPAP board does the following:

- Provides the interface between the PC and the TR boards
- Provides the interface between the PC and the demodulator board
- Receives control data sets from the PC, processes them for specific register values, and sends them to the TR boards
- Houses the transesophageal echocardiography (TEE) transducer interface circuitry (TEE motor control and temperature monitoring)
- Houses the transducer ID circuitry
- Detects the presence of standalone transducers
- Houses electronic switching that allows selection of a single active transducer from the four that can be connected
- Controls the high-voltage output from the system power supply

Omni TEE Circuitry

The OmniPlane control circuitry on the BPAP board supplies power to the TEE transducer's motor. It also measures the position of the angle-position sensor. The signal is digitized and sent to the APIO board for monitoring by the PC.

The beam processor circuitry monitors thermistors in the transducer and ensures that high voltage is not applied to the transmitter unless the thermistor values are within limits.

Demodulator Board

The demodulator board performs image and Doppler demodulation for BMode, MMode, PW and CW phased and nonimaging Doppler modes, and color flow mode. It sends a baseband data stream to the BPAP board.

The demodulator board contains the following:

- Digital filters and mixers for demodulating 2D, color flow, and PW RF data
- The independent transducer CW Doppler electronics and steerable CW detector functions
- The 120-MHz system clock. The clock signal is distributed to the TR and BPAP boards.
- Circuitry that generates TGC signals

APIO Board

The acoustic processor I/O (APIO) board is the token ring interface between the system's PC and the e-box. The APIO board also handles input from the foot switch's three control buttons (via the I/O panel) and forwards them to the PC. The board also generates trigger signals for legacy printers.

The board handles these signals from the PC:

- The R-wave pulse from the physio module that it sends to the BPAP board
- The DC on-off bit that it sends to the power supply
- Commands that program the BPAP board at startup
- Acoustic data from the BPAP board for the acoustic imaging display

Physio Module Option

The self-contained Physio module resides in one of the PC's drive bays. The module receives power from the drive bay's power connector, but it communicates with the system through a USB cable to the PC's motherboard. A shielded and grounded enclosure prevents electromagnetic interference. For a detailed representation of the module's functions and connections, see Figure 4-4 on page 61.

Primary Functions

The module's primary functions are as follows:

- Process ECG signals from patient electrodes and deliver the data to the M2540A's PC
- Send a detected R-wave trigger to the APIO board for frame triggering in various scanning modes
- Provide gain control for ECG waveforms

Connectors

The Physio module has two connectors on its front panel:

- The ECG-input connector is a round, 12-pin connector that is isolated from chassis ground.
- A ¼-inch phone plug jack accepts auxiliary input and has both signal and shield grounds.

System Motherboard

The system motherboard connects all data paths between the TR boards, the BPAP board, and the distribution board. It is also the distribution point for DC power and ground to all boards (the BPAP board and distribution board also receive power directly from the system power supply). It also sends filtered high voltage to the TR boards.

Distribution Board and Connector Modules

The distribution board passes transducer signal inputs to the imaging system. The system power supply provides high voltage directly to the distribution board to fire transducers.

Signals that pass through this board include

- Transducer identification signals from the BPAP board to and from the transducer
- Transmit and receive signals from the TR boards to the active transducer
- TEE motor-control and temperature-sense signals from the BPAP to and from the TEE transducer

Transducer Connector Module Types

The four transducer module bays accept the following types of modules in any combination:

- Cannon, or standard, connector
- AdvanceVision, or cartridge, connector
- Pencil-type transducer connector
- Blank module

For a list of the modules and their part numbers, see Table 13-2 on page 231.

I/O Panel

The I/O panel bears four connectors and two ground points. The main system ground used for safety testing, and an equipotential post are the two ground points on the panel.

The I/O panel's connectors are

- An RJ-45 (CAT 5) connector for connection to a LAN
- A BNC connector that carries composite video signals for a video-input printer
- A BNC connector that carries trigger signals for a video-input printer
- A 9-pin D connector for the optional foot switch

System Control Panel

The system control panel contains the circuitry to process control inputs, the system keyboard, rotary and slide controls, and the trackball and includes the following:

- A USB cable that provides power for the QWERTY keyboard, trackball, and the Enter and Select keys
- An auxiliary cable that provides power for the rest of the keyboard keys, backlighting, and the amplifier for the speakers

All control inputs and LEDs are controlled by the system's PC, and their functions are determined by resident control-panel and system software.

Circuit boards inside the system control panel are not field serviceable or replaceable. The entire assembly, including circuit boards, bezel assembly, and labels, is available as a replaceable part. Rotary and sliding knobs, rotary encoders for the knobs, the trackball assembly, and the trackball cable are all available as separate parts.

Power Supply

The M2540A power supply is a self-contained unit that accepts AC input from 90 V to 264 V, at 50 Hz or 60 Hz, and supplies 120 VAC at 60 Hz to the system's PC, monitor, and two peripherals. It also provides all DC power required by system components. No switch settings are required to configure the power supply for different AC mains; the power supply automatically adjusts to use the power connected to it. Except for the 120 VAC to the PC, all power output is activated by a signal from the PC. The system cooling fan is the only serviceable part on the power supply. For details of the power supply's output, see Figure 4-2 on page 58. The power supply activates when it receives an "AWAKE_N" signal, which is generated by the PC, and then sent through the BPAP board to the power supply.

The system power supply does the following:

- Provides DC power to all system electronics through the system motherboard and the BPAP board
- Provides DC power directly to the system cooling fan
- Provides high voltage to the distribution board for multiplexing transducers
- Isolates AC mains from secondary AC and DC circuitry
- Transforms primary voltages to secondary voltages
- Filters line AC
- Provides an isolated 120 VAC unswitched outlet to power the internal PC
- Provides three isolated 120 VAC switched outlets to power the monitor and two peripherals

Functional Block Diagrams

This section contains block diagrams of the system's components and their connections.

The section includes the following block diagrams:

- Figure 4-2 on page 58 shows the ultrasound system with the VCR option installed. This diagram does not include the e-box or the system's power supply. Those components are shown in Figure 4-3 on page 59.
- Figure 4-3 on page 59 shows the e-box and the system power supply and their connections to other components of the ultrasound system.
- Figure 4-4 on page 61 shows the optional Physio module and its internal connections.

System Functional Block Diagrams

Figure 4-1 shows an overview of the M2540A system PC board functions and interconnections. Figure 4-2 shows a detailed system block diagram.

Figure 4-1 PC Board Block Diagram

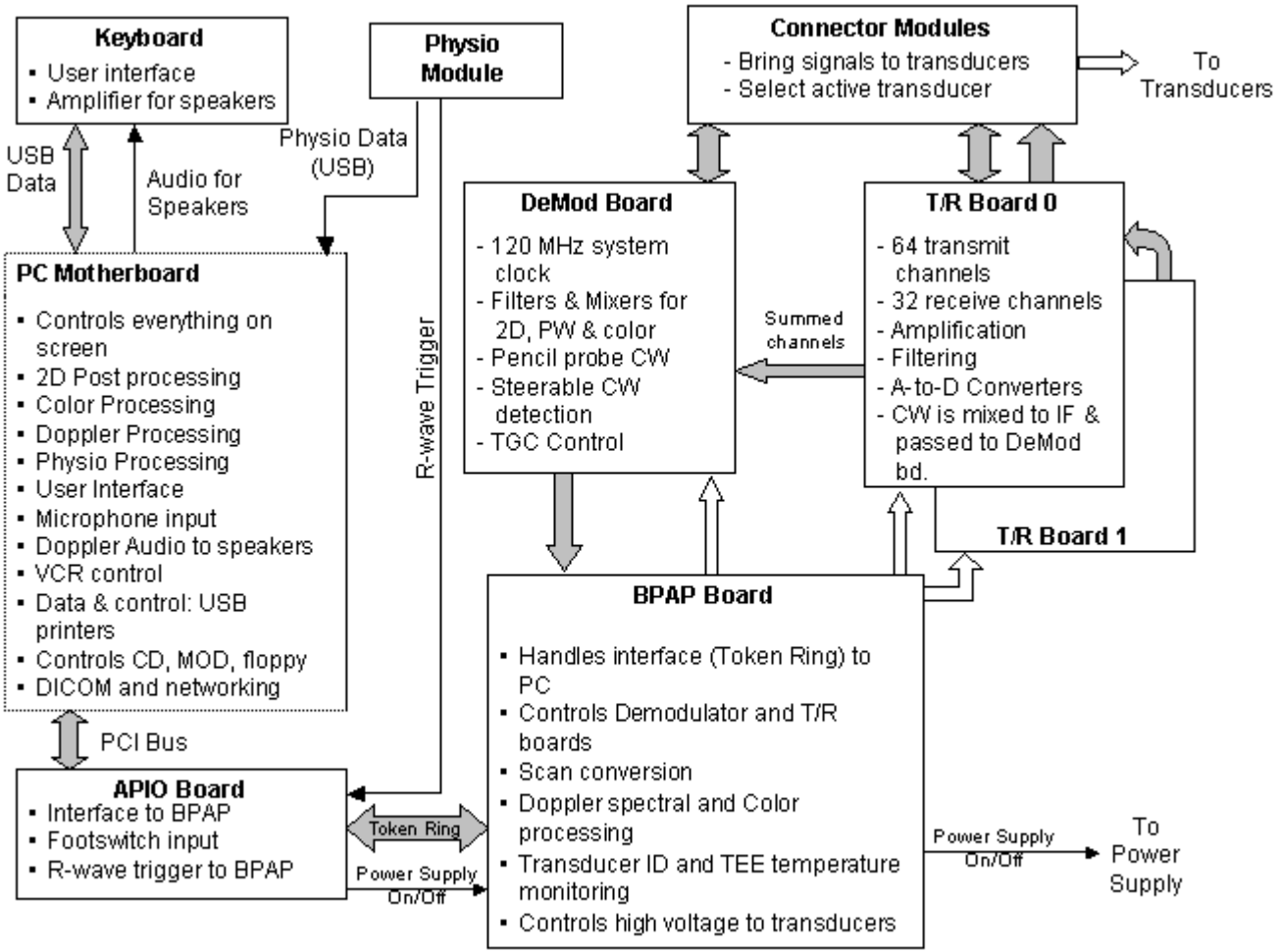
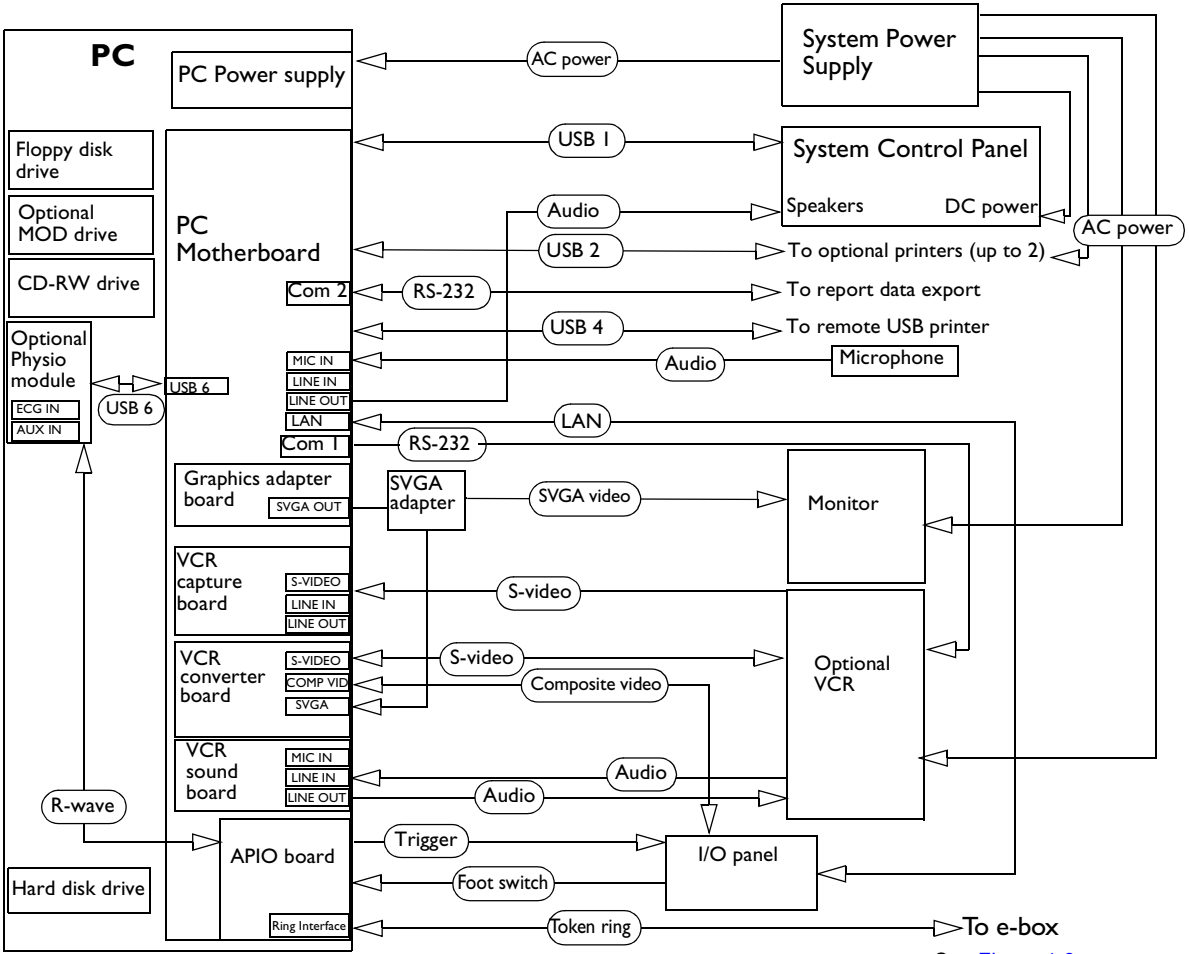


Figure 4-2 System Block Diagram

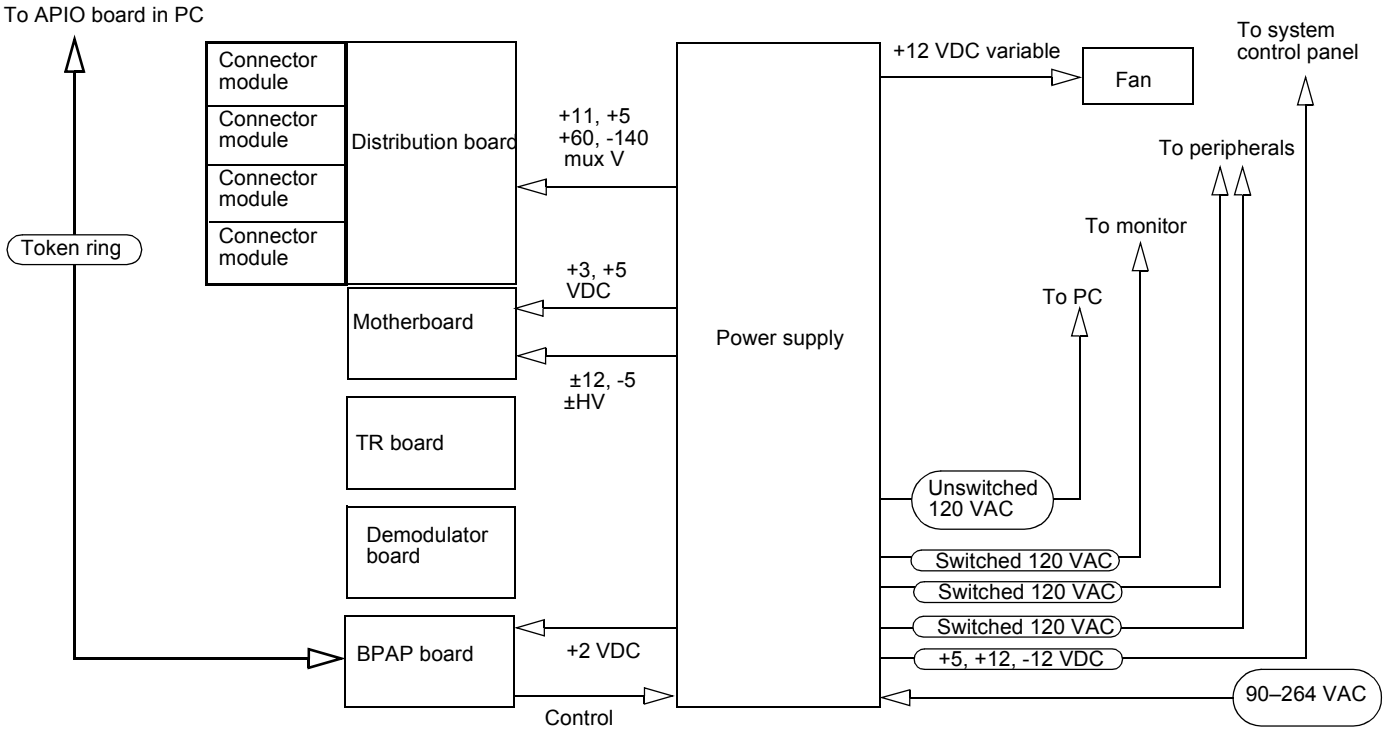


See Figure 4-3

E-box and Power Supply Functional Block Diagram

Figure 4-3 shows the system's power supply and the e-box and their connections to each other and other components.

Figure 4-3 E-box and Power Supply Block Diagram



Token Ring Cable

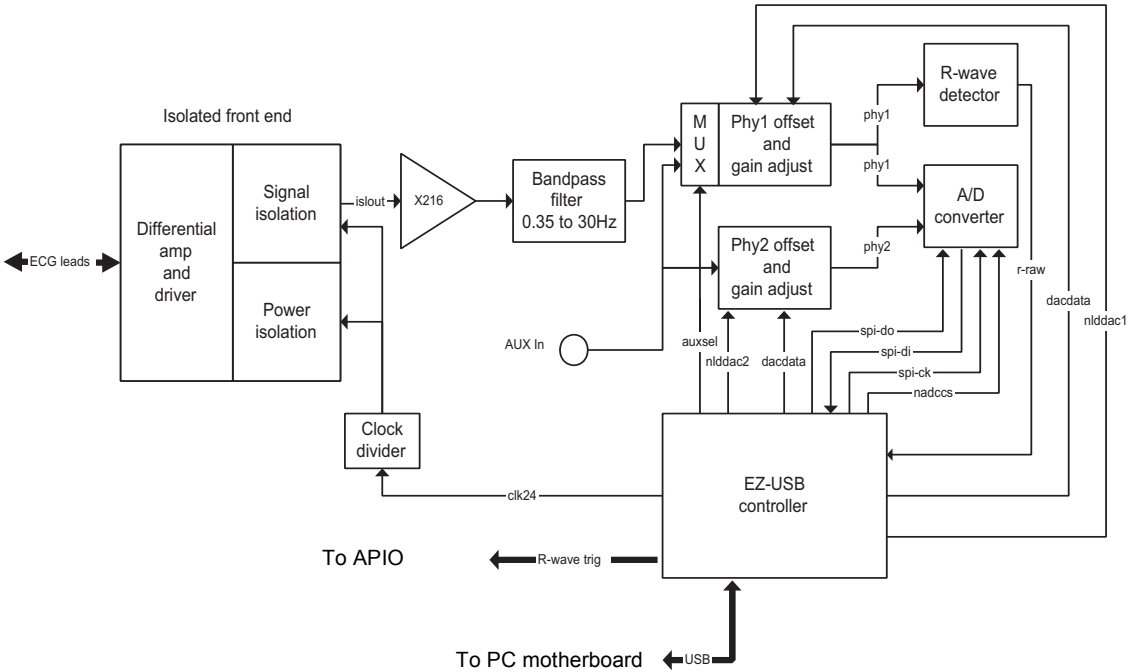
The token ring cable carries the following signals between the BPAP board and the APIO board:

- R-wave communication
- On and off signal that switches on the outputs from the power supply (the 120 VAC output for the PC is always on)
- Program enable and program done (on separate circuits)
- Ring in and ring out (on separate circuits)

Physio Functional Block Diagram

Figure 4-4 shows how the Physio module functions, its internal connections, and connections to other components.

Figure 4-4 Physio Module Block Diagram



Transducer Safety Testing: Test Setup and Theory

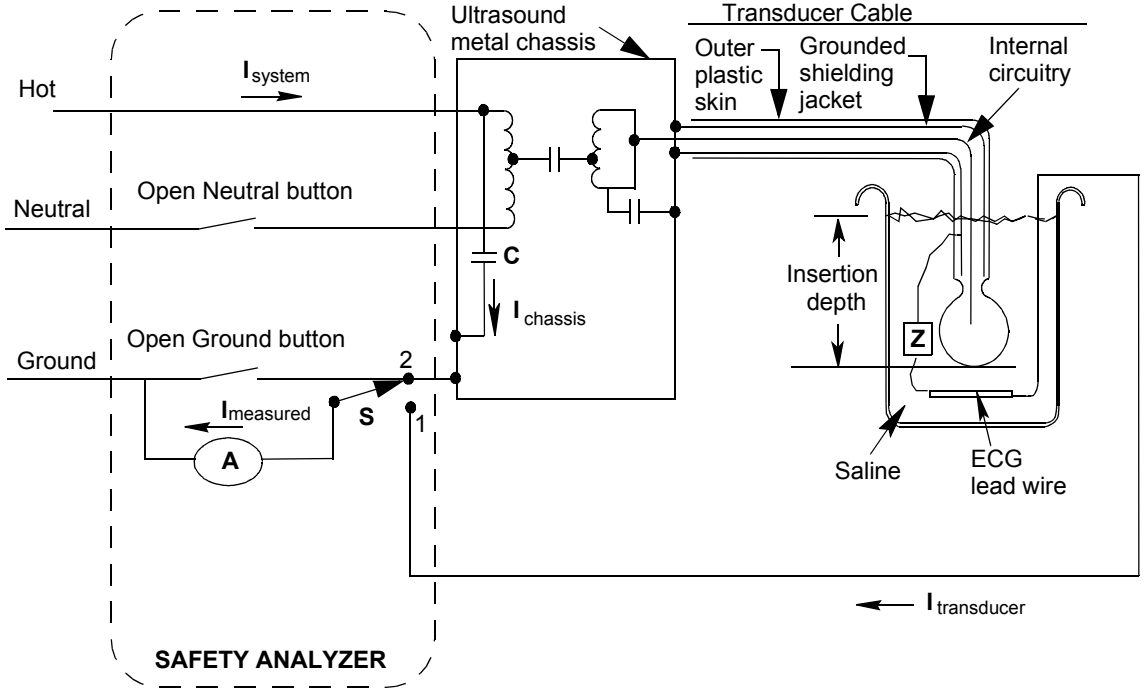
This section provides background and supporting information for the transducer leakage tests in Section 6, "Performance Tests"; this information is not required to perform the tests.

In transducer safety tests, a container filled with saline solution functions as a conductive medium (see Figure 4-5 on page 63). The solution penetrates any faults in the transducer insulation and provides an electrical path between the submerged lead wire and the grounded inner transducer shield.

The test for transthoracic and endocavity transducers differs from the test for TEE transducers only by the extent that the transducers are submerged in the test solution.

Figure 4-5 Transducer Leakage Current Test Setup and Theory Diagram

See Table 4-1



Neutral condition: Closed for normal condition
Closed for 1st single fault condition
Open for 2nd single fault condition

Ground condition: Closed for normal condition
Open for 1st single fault condition
Closed for 2nd single fault condition

Mode selector on safety analyzer: ECG for transducer leakage test
Case Leakage, Ground Conductor for ground wire leakage test

7ASW030-1

Table 4-1 Key for Figure 4-5

A	=	Microammeter in the safety analyzer
$I_{measured}$	=	Leakage current
S	=	Switch that connects the ammeter either directly to the chassis or through the ECG lead wire. (This is the mode selector on the Safety Analyzer. Select ECG for transducer leakage and Case Leakage, or select Ground Conductor for chassis leakage.)
C	=	Stray capacitance from the system's power wiring to the chassis.
Z	=	Impedance between the transducer's metal parts and the test electrode: $\approx$ 800 KΩ if the outer insulating layer is intact $<$ 500 Ω if the outer layer is compromised

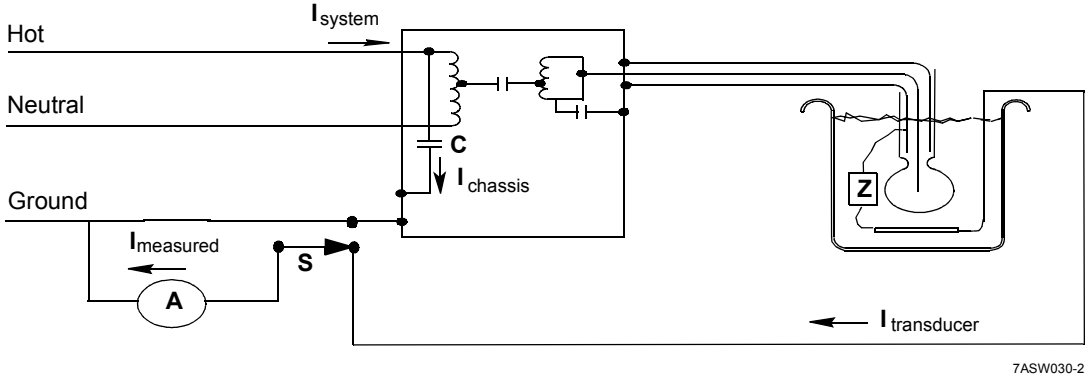
Insertion depth:

- For transthoracic and endocavity transducers, submerge the head and 5 cm of the cable, being careful to not submerge the connector.
- For TEE transducers, submerge all of the flexible shaft that would normally enter the body of the patient: 100 cm for adult TEE, 60 cm for pediatric TEE.

Theory of the Transducer Leakage Current Test

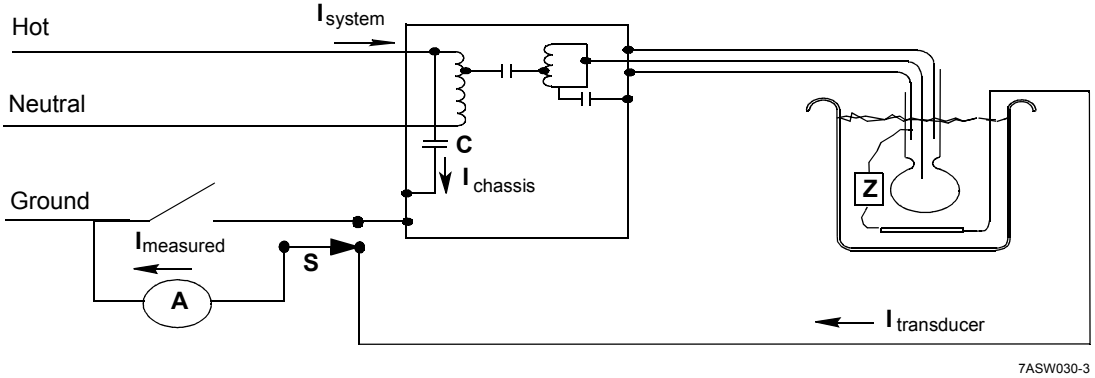
Leakage current $\mathbf{I}_{chassis}$, driven by the line supply, flows through the stray capacitance **C** between the primary wiring and the system's metal chassis.

Figure 4-6 Transducer Leakage Current Test Diagram for the Normal Condition



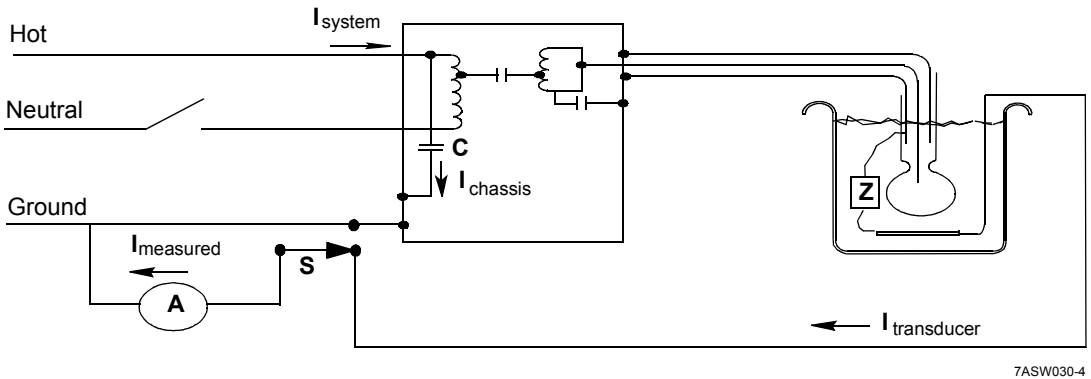
The leakage current normally flows from the chassis safely out through the ground wire. If there is a fault in the transducer insulation, some of the current follows this path and is measured by the safety analyzer. This $\mathbf{I}_{transducer}$ is still fairly low, unless the chassis is not properly grounded.

Figure 4-7 Transducer Leakage Current Test Diagram for 1st Single Fault Condition



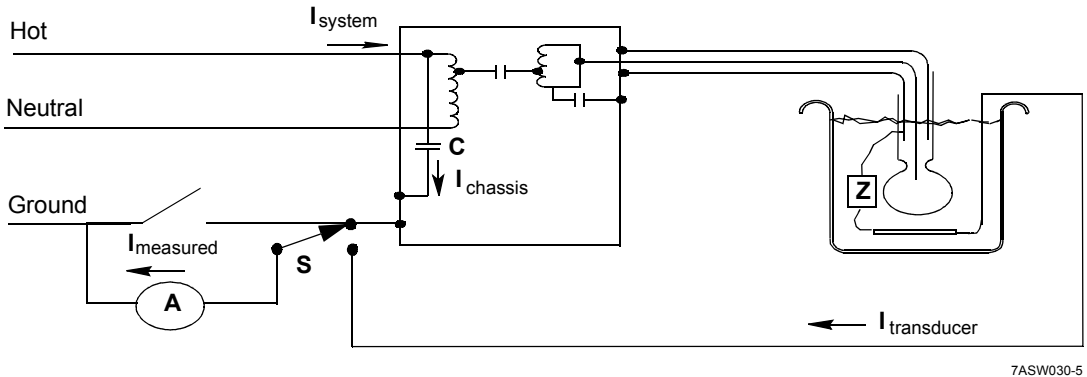
When an open ground condition is imposed, all $I_{chassis}$ is forced through the transducer. This $I_{transducer}$ is still fairly low unless its sheath is compromised.

Figure 4-8 Transducer Leakage Current Test Diagram for 2nd Single Fault Condition



Imposing an open neutral condition prevents all system current from flowing. This creates a higher potential for leakage current $I_{chassis}$. Most flows safely through the ground wire; some flows through the transducer. This $I_{transducer}$ is still fairly low, unless the chassis is not properly grounded.

Figure 4-9 Ground Wire Leakage Test Diagram (for Comparison with 1st Single Fault Condition)



With the transducer circuit disconnected, all of the leakage current $I_{chassis}$ flows through the analyzer by way of the ground wire.

In the 1st single fault condition transducer leakage test (Figure 4-7 on page 66), all the leakage current $I_{chassis}$ flows through the analyzer by way of the transducer. In that condition, only the resistance or impedance of the respective paths varies.

- If the transducer sheath is intact, its resistance is high, and $I_{measured}$ in the transducer leakage test is low when compared with $I_{measured}$ in the ground wire leakage test.

- If the transducer sheath is compromised, its resistance is close to that of the ground wire. Transducer leakage current equaling 80% or more of ground wire leakage current indicates a fault or break in the transducer insulation.

Sheath integrity is tested this way because there could be a break in the transducer sheath causing significant $\mathbf{I}_{transducer}$, and yet that leakage current could still be within acceptable limits. Comparison to the ground wire leakage current is the only way to ensure sheath integrity.

5 Installation

Overview

This Section includes procedures for installing and setting up the M2540A.

Installation Checklist

Use the following checklist to verify all necessary installation steps are performed.

Assemble the system, see page 70. ❑
- Install the system power cord, see page 70). ❑
- Install the monitor, see page 70). ❑
- Install peripherals, see page 70). ❑

Start up the system, see page 73. ❑
- Power on the system, see page 73. ❑
- Set the monitor input voltage see page 73. ❑
- Prepare the printer or printers, see page 75. ❑

Configure the system, see page 76. ❑
- Set the localization parameters, see page 76. ❑
- Install options, see page 84. ❑
- Configure the DICOM network, if required see page 87. ❑
- Configure the system hardware see page 105. ❑

Train the customer, see page 110. ❑

Assemble the System

Complete the following steps to assemble the M2540A ultrasound system:

Power Cord and Monitor Installation

➤ **Installing the Power Cord and Monitor**

1. Attach the system power cord to the receptacle at the bottom rear of the system.
2. Loosen the screw that secures the cord retainer, rotate the retainer 180 degrees, and tighten the screw.
3. Rotate the twivel base to its proper position. (The monitor cables pass through the rear of the twivel base.)
4. Install the monitor on the twivel.
5. Connect the VGA cable the and monitor power cable to the monitor.

Peripherals Installation

When installing peripherals, keep the following points in mind:.

- When two peripherals are installed, the smaller one must be on top of the larger one.
- Peripherals should mount toward the rear of the system, with about 1 cm (0.4in) between the lower peripheral and the inside edge of cart top.
- See Help or the Peripherals Setup screen for a list of compatible printers.

➤ Installing a VCR

1. Loosen the peripheral strap, and slide the VCR under it.
2. Connect the power cable, audio input cable, audio output cable, and S-Video cable to the VCR.
3. Connect the serial cable to the VCR, and screw it in place.
4. If another peripheral is part of the installation, place the VCR peripheral tray on the top of the VCR.
5. Tighten the peripheral strap on top of the peripherals.
6. Turn on the VCR power switch.
7. Set the VCR switches to the following settings:
   - Audio Out left switch: **Mix**
   - Audio Out right switch: **Norm**
   - Input: **S-Video**
   - S-VHS: **Auto**
   - Menu: **Off**
   - Mode Lock: **Off**
8. Save the VCR manual and any other documentation from the shipping box.

➤ Installing a Sony Color Printer

NOTE If a VCR is also part of the installation, install it with its tray *before* the printer.

1. Loosen the peripheral strap, and slide the printer under it.
2. Connect the power cable and a USB cable to the printer.

3. Take a cable stop bracket from the accessories shipping box and slip it onto the peripheral strap.
4. Hook the bracket in a slot of the cart top or the peripheral tray so the bracket is as close as possible to the printer.
5. Tighten the strap.
6. Switch the printer power switch on.
7. Save the following material from the printer's shipping box:
   - Printer paper
   - Print ribbon
   - Cleaning ribbon
   - Printer manual
   - Any other documentation

➤ Installing a Sony Black and White Printer

NOTE If a VCR or color printer is also part of the installation, install it with its tray *before* the black and white printer.

1. Loosen the peripheral strap, and slide the printer under it.
2. Connect the power cable and a USB cable to the printer.
3. Take a cable stop bracket from the accessories shipping box and slip it onto the peripheral strap.
4. Hook the bracket in a slot of the cart top or the peripheral tray so the bracket is as close as possible to the printer.
5. Tighten the strap.

6. On the back of the printer, set ALL dip switches down to the ON position.
7. Switch the printer power switch on.
8. Save the following material from the printer's shipping box:
   - Thermal paper
   - Cleaning sheet
   - Printer manual
   - Any other documentation

System Startup

Complete the procedures in this section to set up the system for the customer's use.

➤ **Powering On the System**

1. Connect the system power cord to a wall outlet.
2. Press the power switch on the front of the system's PC.

Monitor Signal Voltage

When shipped from the factory, the monitor signal input voltage is set to 1.0 V. This must be reset to 0.7 V, using the following procedure:

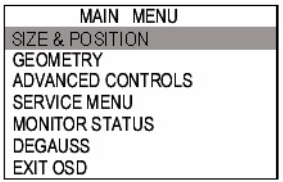
➤ **Setting the Monitor Signal Input Voltage**

1. Disconnect the power cord from the rear of the monitor.
2. Hold down the two right-hand monitor buttons and reconnect the power cord. Continue holding the buttons until you see an image.
3. Press the two center monitor buttons.

NOTE Do not press the two center buttons for longer than 10 seconds or the OSD menu locks and you will not be able to make any adjustments. To unlock the menu, press the two center buttons for more than 10 seconds or until the unlocked message appears and then release the buttons. Press the buttons again until the Main Menu appears.

The OSD Main Menu appears.

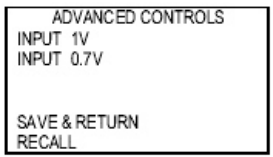
Figure 5-1 OSD Main Menu



4. Use the two right-hand monitor buttons to scroll up or down the OSD Main Menu to select **Advanced Controls**.
5. Press the far left monitor button.

   The Advanced Controls menu appears.

Figure 5-2 Advanced Controls Menu



6. Use the two right-hand monitor buttons to select **INPUT 0.7V**.

7. Press the far left monitor button.
8. Use the two right-hand monitor buttons to select **SAVE & RETURN**.
9. Press the far left monitor button.
10. On the OSD Main menu, use the two right-hand monitor buttons to select **EXIT OSD**.
11. Press the far left monitor button to exit the OSD menus.

Printer Preparation

➤ **Preparing the Sony Black and White Printer**

1. Load thermal paper in the printer's paper drawer.
2. Set the paper type switch inside the printer's paper drawer to the loaded paper type. (The paper type is marked on the paper's foil wrapper, and on the tube at the center of the paper roll.)

➤ **Preparing the Sony Color Printer**

1. Load paper in the printer's paper tray.
2. Insert the paper tray in the printer.

NOTE The paper tray does not sit flush with the printer's front.

3. Turn the printer power on, to move the print head from its shipping park position.
4. Load the print ribbon.

NOTE Be sure to use the print ribbon and not the cleaning ribbon.

System Configuration

Use the following procedures to configure the system software.

NOTE If the system is to communicate over a network, the customer site's network administrator must be available to supply configuration data.

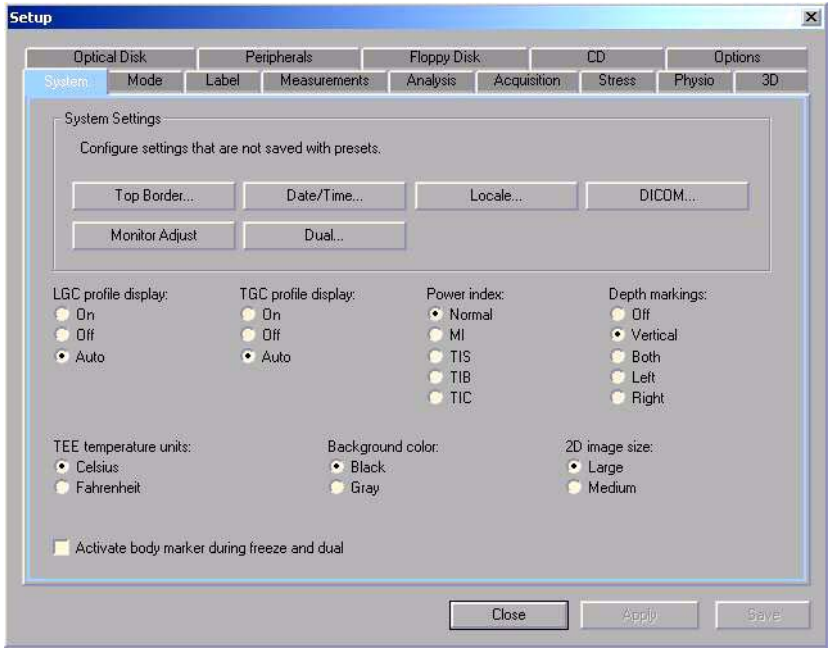
Setting the Institution Name

To set the institution name:

1. Press **Setup**.

   The Setup window opens.

Figure 5-3 Setup Window



2. Click the **System** tab.
3. Click the **Top Border** button.

   The Top Border window opens.

Figure 5-4 Top Border Window

4. Type the institution name, and click **OK**.

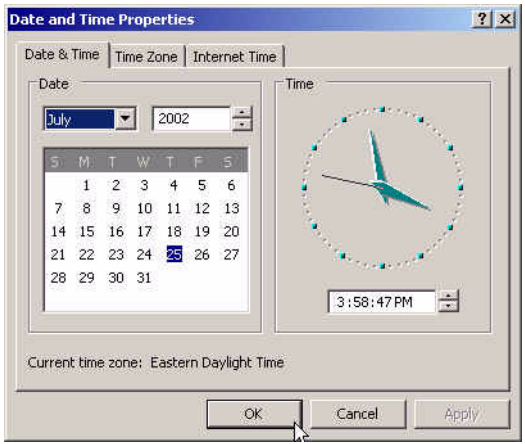
Setting the Date and Time

To set the system date and time:

1. On the Setup window, click the **Date/Time** button.

The Date and Time Properties window opens.

Figure 5-5 Date and Time Properties Window



2. Click the **Time Zone** tab.
3. Click the drop-down list and select the local time zone.
4. Click the **Date & Time** tab.
5. Change the settings to the local date and time, and click **OK**.

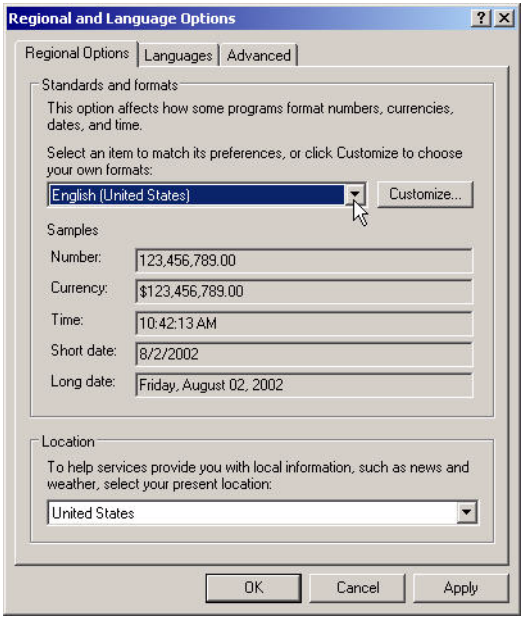
Setting the User Interface Language

To set the user interface language:

1. On the Setup window, click the **Locale** button.

   The Regional and Languages Options window opens.

Figure 5-6 Regional and Languages Options Window (Regional Options)



2. Click the drop-down list in the **Standards and formats** section and select the configuration in the list that most nearly matches the site locale.
3. If the number, currency, time, or date formats in the selected configuration set do not match the site locale, click the **Customize…** button and change the incorrect settings.

NOTES

- Customizing the date format to one that is longer than any in the drop-down list may cause dates in the display to be truncated.
- The language in which the Help is displayed is determined by the locale selected in Standards and formats section (step 2), if that language is available. If the selected language is not available, Help is displayed in the same language as the rest of the system.

4. Click the **Location** drop-down list, and select the location that most nearly matches the site.
5. On the Regional and Languages Options window, click the **Languages** tab.

Figure 5-7 Regional and Languages Options Window (Languages)

Regional and Language Options
Regional Options
Languages
Advanced
Text services and input languages
To view or change the languages and methods you can use to enter text, click Details.
Details...
Supplemental language support
Most languages are installed by default. To install additional languages, select the appropriate check box below.
Install files for complex script and right-to-left languages (including Thai)
Install files for East Asian languages
Language used in menus and dialogs
English
OK
Cancel
Apply

6. Click the **Language used in menus and dialogs** menu, and select the local language.
   Choose from the following languages *only*.
   - English
   - French
   - German
   - Spanish
   - Italian
   - Chinese (simplified or PRC)
   - Japanese
   - Russian

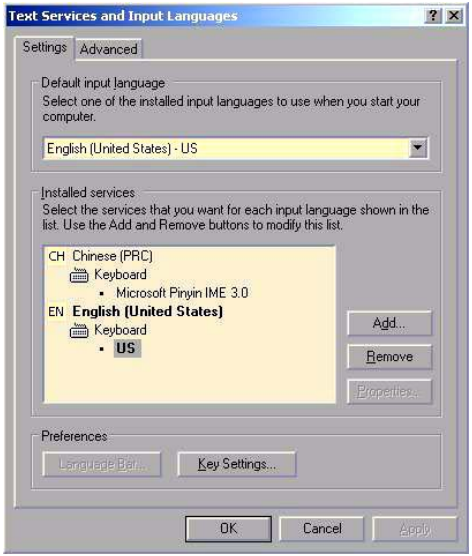
NOTE When the Standards and formats language is set to Japanese, the Patient ID screen allows three name representations: Roman, phonetic, and ideographic. The Roman representation is required and accepts ISO-8859-1 characters. The phonetic representation is intended for Kana and the ideographic representation is intended for Kanji. All representations appear in reports.

Setting the Input Language

To set the Input language:

1. On the **Regional and Languages Options** window, click the **Details…** button.
   The Test Services and Input Languages window opens.

Figure 5-8 Text Services and Input Languages Window



2. In the Installed services section, add or remove input languages.

If the customer's language …	Then install the …
is represented on the United States-International keyboard	**English (United States)-US** keyboard *only*. Set the default input language to **English (United States)**.
is not represented on the United States-International keyboard	**English (United States)-US** keyboard *and* the customer-requested input language. Set the default input language to the customer-requested language.

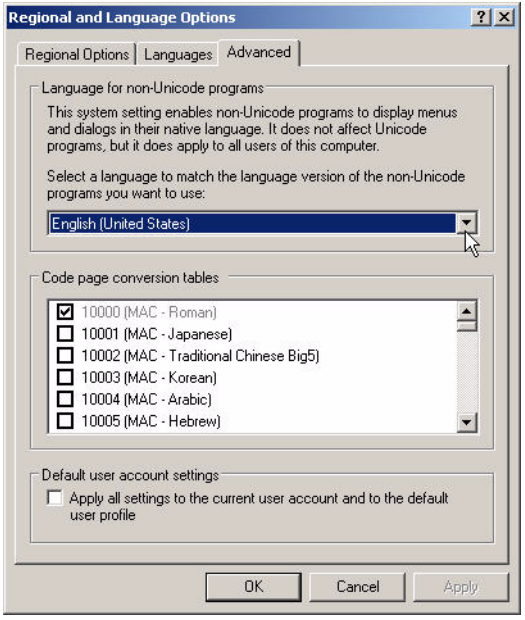
3. To modify the input language features, highlight the keyboard icon and click the **Properties…** button.
4. Click **OK** when you are finished.

Setting the System Code

To set the system code:

1. On the **Regional and Languages Options** window, click the **Advanced** tab.

Figure 5-9 Regional and Languages Options Window (Advanced)


Regional and Language Options
Regional Options
Languages
Advanced
Language for non-Unicode programs
This system setting enables non-Unicode programs to display menus and dialogs in their native language. It does not affect Unicode programs, but it does apply to all users of this computer.
Select a language to match the language version of the non-Unicode programs you want to use:
English (United States)
Code page conversion tables
10000 (MAC - Roman)
10001 (MAC - Japanese)
10002 (MAC - Traditional Chinese Big5)
10003 (MAC - Korean)
10004 (MAC - Arabic)
10005 (MAC - Hebrew)
Default user account settings
Apply all settings to the current user account and to the default user profile
OK
Cancel
Apply

2. Click the drop-down menu and select the **language for non-Unicode programs**. The selection should be the one that most closely matches the chosen interface language.

3. Click **OK** to close the Regional and Languages Options window.

NOTE After any change to settings in the Regional and Language Options window, reboot the system. You may be prompted to restart or to "use existing files." Click **Yes** in either case.

Installing Options

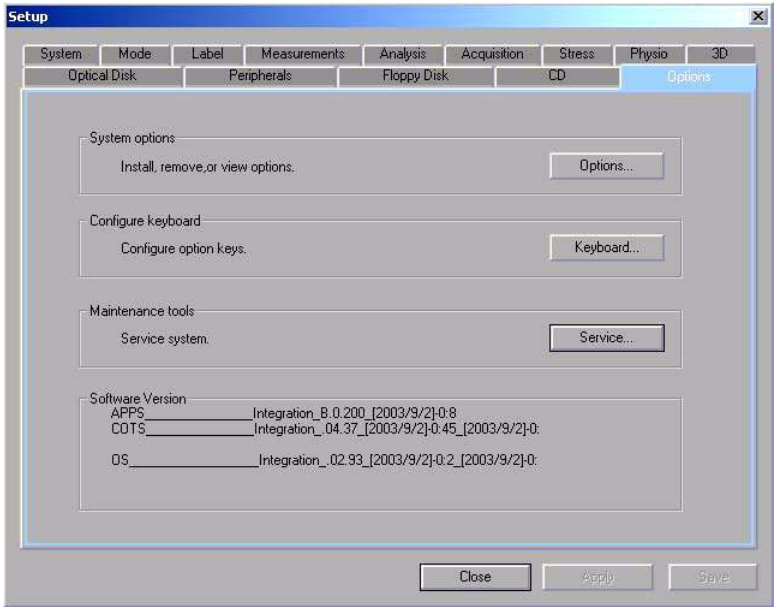
The M2540A leaves the factory with all purchased options enabled. If an option must be enabled in the field, complete the following procedure. Before you begin, obtain the access code from designated access code tool users.

➤ Installing Software Options

To install options:

1. On the Setup window, click the **Options** tab.

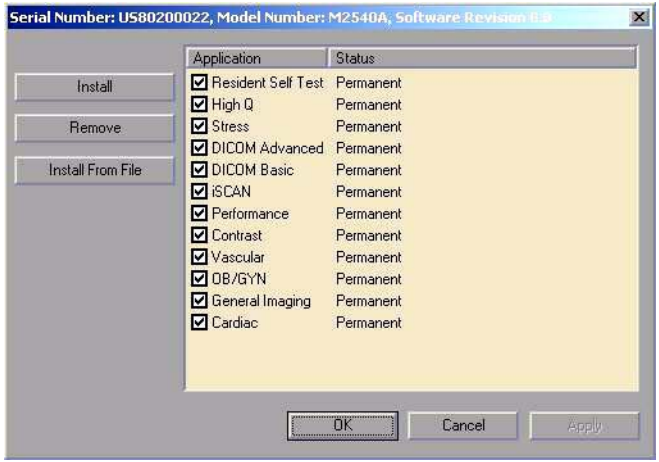
Figure 5-10 Setup Window (Options)



2. Click the **Options...** button.

   An installation window opens.

Figure 5-11 Options Installation Window



3. Select an **application** to enable by clicking it so it is highlighted.
4. Click **Install**.
5. Enter the access code in the window, and click **OK**.

   The selected option is enabled.
6. Repeat **steps 3 through 5** to enable any additional options.
7. When all the required options are installed, click **OK**.

DICOM Network Configuration

Complete the following procedures to configure the system for DICOM communications over a network. The procedure requires information from the customer's network administrator.

➤ Changing the System's Network Parameters

To change the network parameters:

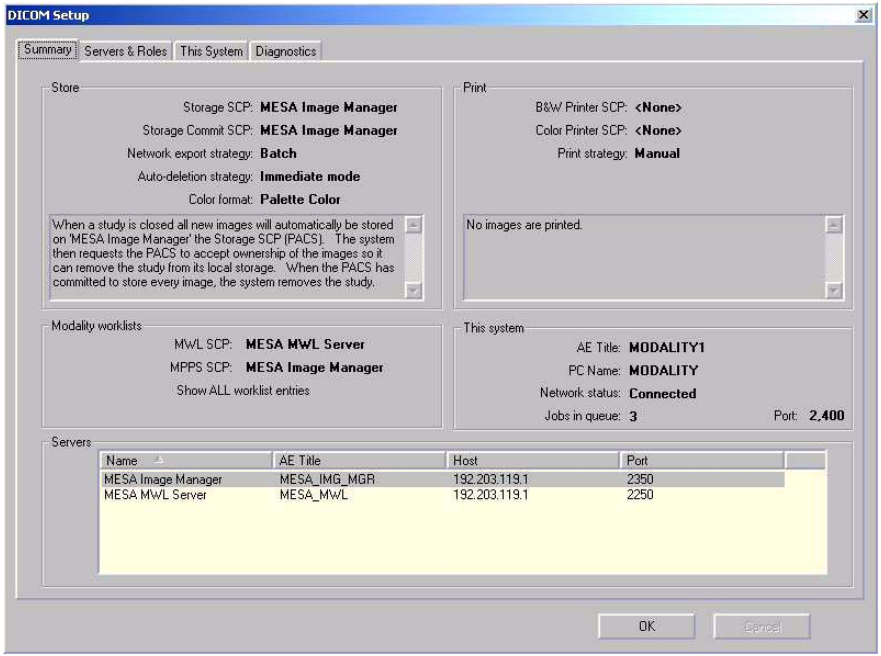
1. Press the **Setup** key.

   The Setup window opens.

2. On the **System** tab, click the **DICOM** button.

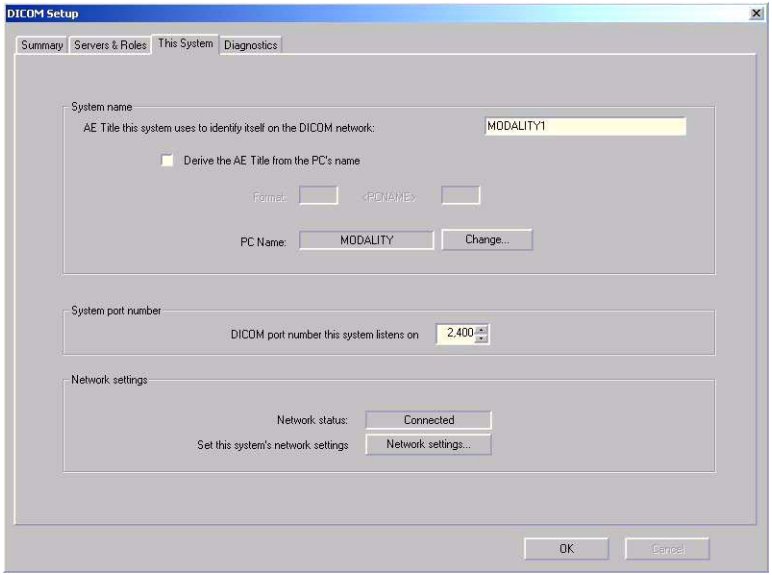
   The DICOM Setup window opens.

Figure 5-12 DICOM Setup Window (Summary)



3. Click the **This System** tab.

Figure 5-13 DICOM Setup Window (This System)



4. Change the AE Title and/or PC name to those provided by the customer for this system:
   a. Change the AE title by typing the name or selecting **Derive the AE Title from the PC's name** and typing the **Format** and **<PCNAME>**.
   b. Change PC name by clicking **Change…**, typing the name in the dialog box that opens, and then clicking **OK**.
5. Click **Network Settings**.
6. In the Internet Protocol (TCP/IP) Properties screen, enter the settings provided by the customer.
7. Click **OK**.

8. Click **OK** again to return to the setup screen.

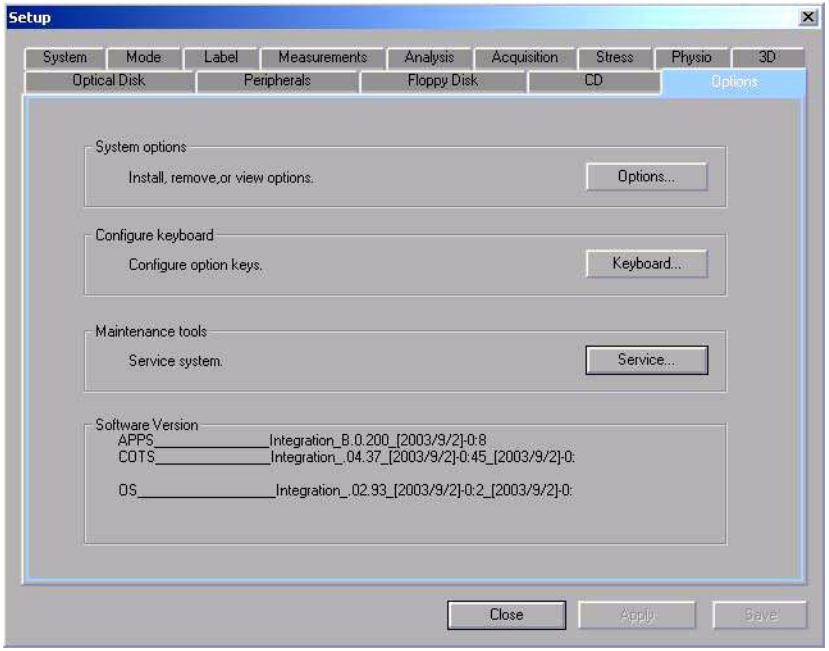
NOTE If the system will join a domain, or if you must enter a network ID, you must use the following procedure to change the network settings.

➤ Accessing Advanced Network Settings

Use the Field Service Options window to access advanced network settings:

1. On the Setup window, click the **Options** tab.

Figure 5-14 Setup Window (Options)

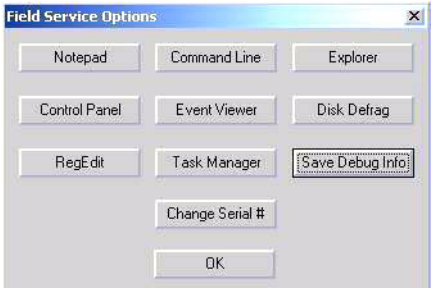


2. Click **Service**.

   The Field Service Options window opens.

3. Type the password and click **OK**.

Figure 5-15 **Field Service Options Window**



4. Click **Control Panel**.

   The Control Panel window opens.

5. Click **Switch to Classic View**.

   The display changes to Windows Classic format.

6. Double-click **System**.
7. Click the **Computer name** tab.
8. Click **Change ...**.
9. Click **Member of Domain...** and type the domain supplied by the customer.
10. Click **OK**.
11. In the confirmation dialog box, click **OK**.

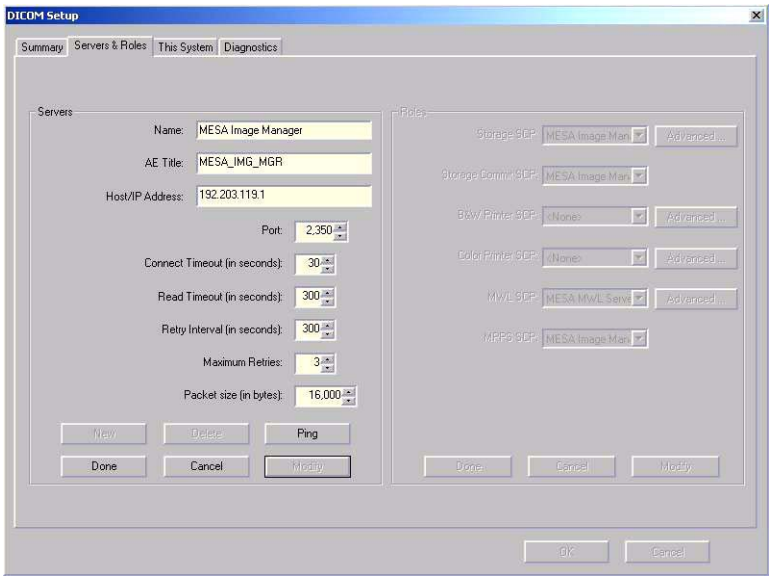
NOTE After opening the Control Panel window, you must reboot the system before it will work as an ultrasound imaging device. This is true even if no settings are changed.

➤ Adding Server Information

To add server information:

1. In the Setup window, on the System tab, click the **DICOM** button.
2. In the DICOM Setup window, click the **Servers & Roles** tab.

Figure 5-16 **DICOM Setup Window (Servers & Roles)—Servers**



3. In the Servers section, click **New**.

4. Enter the server information supplied by the network administrator in the appropriate fields.

NOTES

- AE Titles must be unique on the network and are case sensitive.
- The value in the Name: field need not be the server's DNS or network name. It is used only to identify the server in error messages and dialog boxes.
- The value in the Host: field is the server's IP address, or the name that the DNS server resolves to an IP address.

5. Click **Done**.
6. Make sure the network cable is connected, and click **Ping**.

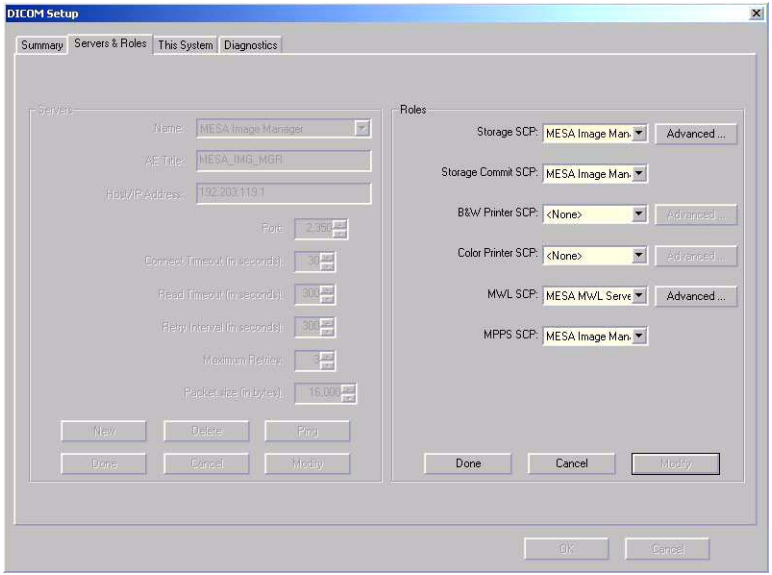
   The M2540A tests communication with the server, and opens a window that shows the result.

➤ Assigning Servers to DICOM Roles

To assign DICOM roles:

1. In the Roles section on the Servers & Roles tab, click **Modify**.

Figure 5-17 DICOM Setup Window (Servers & Roles)—Roles



2. Select the correct server for each role from the drop-down lists.

NOTE Be sure the time is set correctly before assigning any server to MWL SCP role.

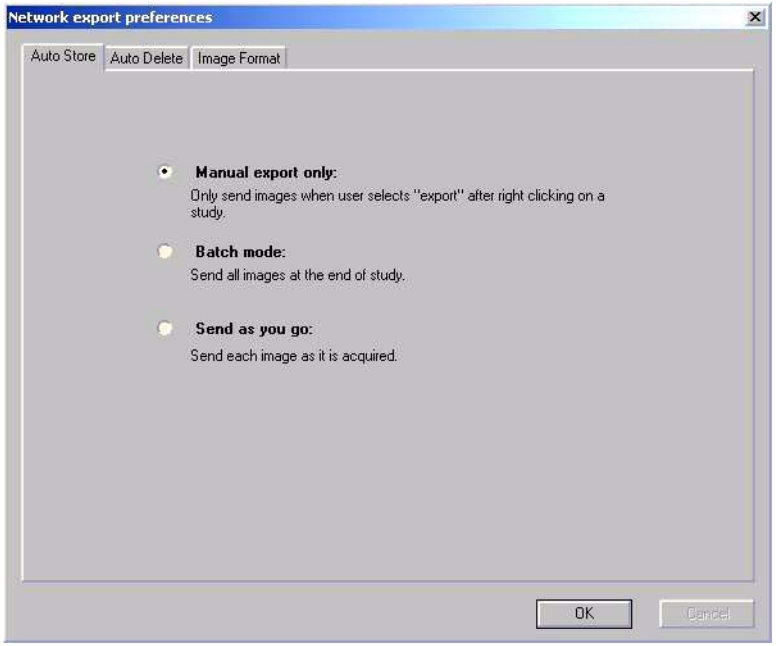
➤ Configuring the Storage SCP

To configure the Storage SCP:

1. Click the **Advanced …** button next to Storage SCP.

The Network export preferences screen opens.

Figure 5-18 Network export preferences Screen


Network export preferences
Auto Store
Auto Delete
Image Format
Manual export only:
Only send images when user selects "export" after right clicking on a study.
Batch mode:
Send all images at the end of study.
Send as you go:
Send each image as it is acquired.
OK
Cancel

2. Click the Auto Store option required by the customer.
3. Click the **Auto Delete** tab.
4. Click the option required by the customer.

NOTE To configure Auto Delete for systems without network connectivity, see "Configuring Autodelete" on page 102.

5. Click the **Image Format** tab.
6. Click the image format required by the customer.
7. If you select JPEG, set the image quality factor.
8. Click **OK**.
9. Create the following studies, send them to PACS, and verify that they can be viewed on the customer's viewer:
   - Black and white still
   - Color still
   - Black and white loop
   - Color loop

➤ Configuring the Printers

The following rules apply to printer setup:

- If you only setup one printer, you must select <None> for any other printer on the DICOM Setup screen.
- If the printer only prints black and white hard copy, try assigning it to **Color Printer SCP** and the printer may be able to monochromized color images with its own algorithms.
  If the print job is rejected using this setting, then assign the printer to **B & W Printer SCP** and the EnVisor system monochromizes the color images before sending them to the printer.
- If only a color printer is set up, black and white images are black and white and color images are color.

- If both a black and white and color printer are set up, black and white images are automatically sent to the black and white printer and color images are automatically sent to the color printer.
- Any change to Auto-Print applies to both the black and white and color printers.

Perform the following procedure for each printer on the system.

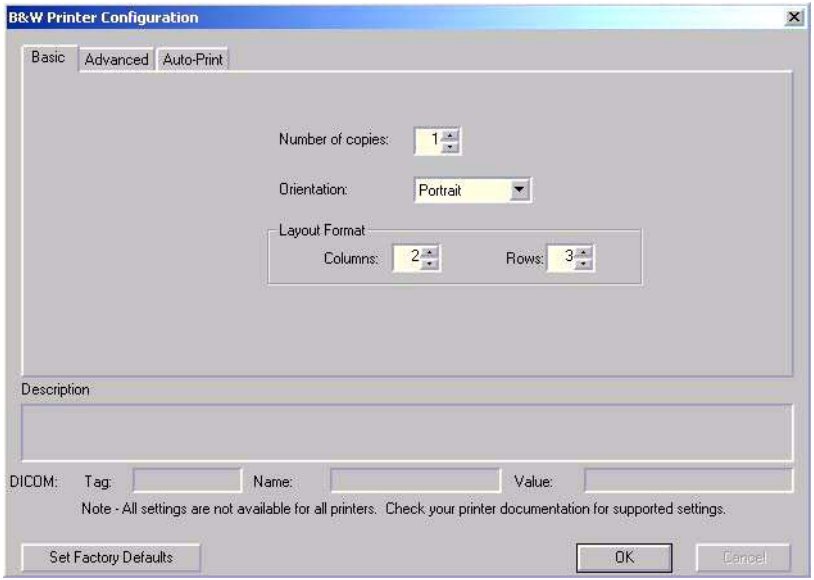
To configure the printers:

1. Click the **Advanced…** button next to the printer you want to configure.

NOTE You must restart the system for any changes you make on the Advanced tab to take effect.

2. The Printer Configuration Screen opens. The Black and White Printer Configuration screen is shown in Figure 5-19.

Figure 5-19 B&W Printer Configuration Screen



3. Configure the printer according to the customer's requirements.
4. Click **OK**.
5. Create still images in black and white and in color, and then print the images to ensure that the printed output looks good.

   If the images are too dark, ask the customer to configure the printer to use an Ultrasound Presentation LUT when receiving images from EnVisor's AE title.

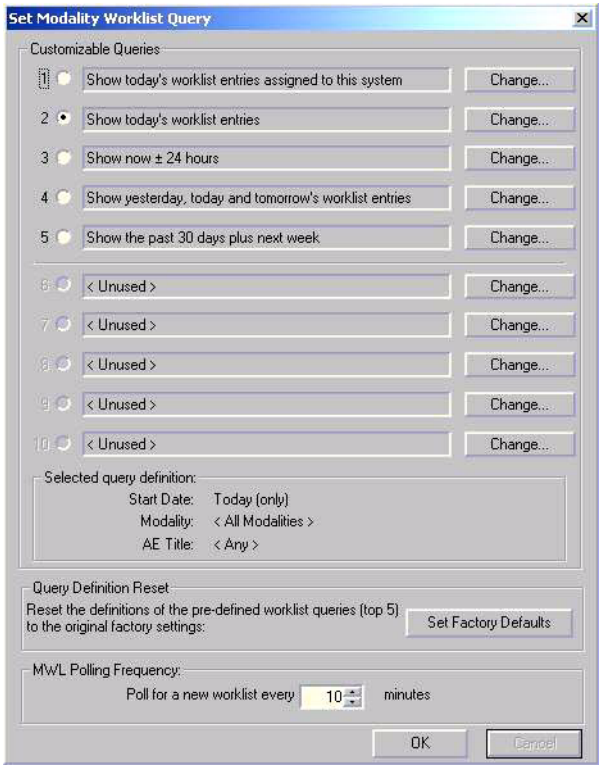
➤ Configuring the MWL Server

To configure the MWL server:

1. Click the **Advanced …** button next to MWL SCP.

   The Set Modality Worklist Query screen opens.

Figure 5-20 Set Modality Worklist Query Screen



2. Either select the predefined query, **Show today's worklist entries**, or configure the **Customizable Queries** according to the customer's requirements.
3. Click **OK**.

➤ Configuring Logging

To configure error logging:

1. On the DICOM Setup window, click the **Diagnostics** tab.
2. Click **Logging**.

   The DICOM Diagnostics window opens.

Figure 5-21 DICOM Diagnostics Window

3. Under System Log, make sure the Logging level is set to **Error Level Logging**.
4. Click **OK**.

Troubleshooting Connectivity Problems

If DICOM transmissions do not work after configuration, pen the Job Manager and determine whether the jobs are in error status.

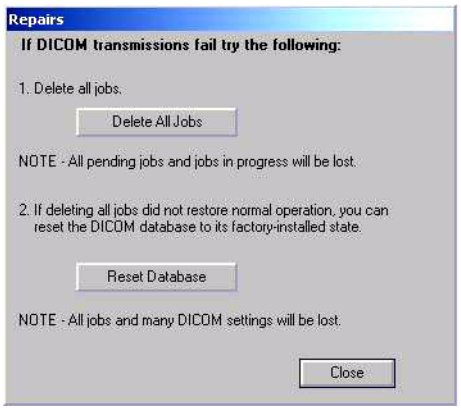
1. Press **Setup**.
2. On the **System** tab, click **DICOM**, and then click the **Diagnostics** tab.

If a job remains in **Progress** and does not go to error or retry status, remove the job with the repair screen as follows:

1. On the DICOM Setup window, click the **Diagnostics** tab.
2. Click **Repairs**.

   The Repairs window opens.

Figure 5-22 Repairs Window


Repairs
If DICOM transmissions fail try the following:
1. Delete all jobs.
Delete All Jobs
NOTE - All pending jobs and jobs in progress will be lost.
2. If deleting all jobs did not restore normal operation, you can reset the DICOM database to its factory-installed state.
Reset Database
NOTE - All jobs and many DICOM settings will be lost.
Close

3. To reset all DICOM settings to the factory default values, remove all jobs from the job manager, and restore the DICOM database to the factory default, click **Reset Database**.

4. Click **Close** when you are finished.

To review the connectivity log for errors:

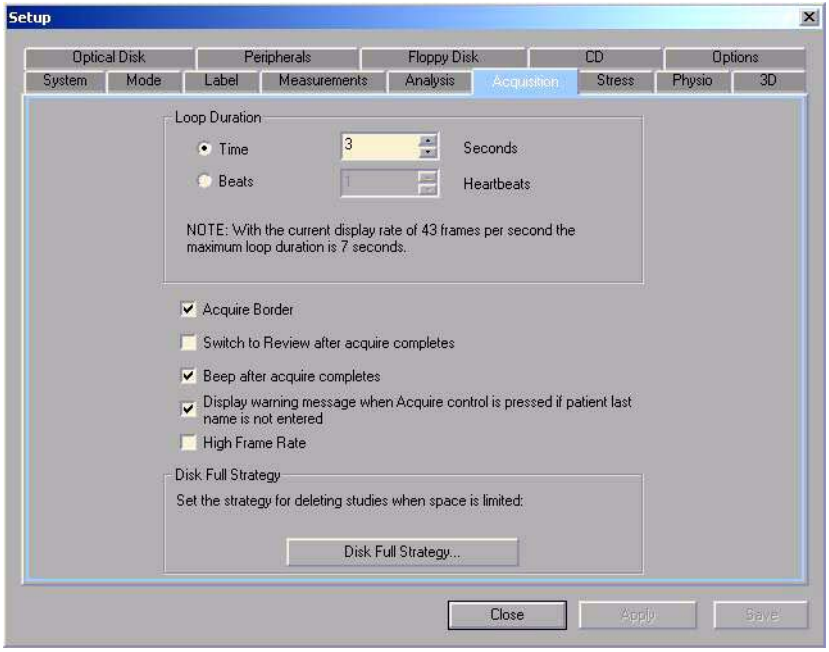
1. On the Setup window, click the **Options** tab.
2. Click **Service**.
3. In the Field Service Options window, click **Notepad**.
4. In Notepad, open the current.log file in the c:\dicommitra\log directory.

Configuring Autodelete

The following procedure configures how the systems without DICOM connectivity automatically delete studies. To configure systems with DICOM connectivity, see "Configuring the Storage SCP" on page 94.

1. On the Setup Window, click the **Acquisition** tab.

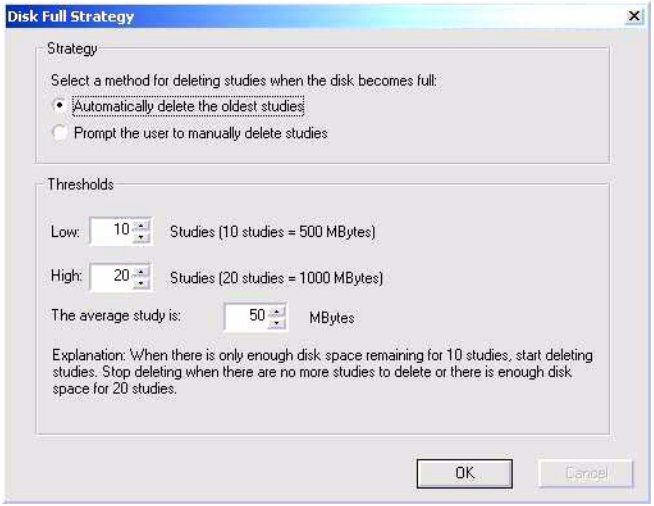
Figure 5-23 Setup Window (Acquisition)



2. Click **Disk Full Strategy...**.

   The Disk Full Strategy window opens.

Figure 5-24 Disk Full Strategy Window


Disk Full Strategy
Strategy
Select a method for deleting studies when the disk becomes full:
Automatically delete the oldest studies
Prompt the user to manually delete studies
Thresholds
Low: 10 Studies (10 studies = 500 MBytes)
High: 20 Studies (20 studies = 1000 MBytes)
The average study is: 50 MBytes
Explanation: When there is only enough disk space remaining for 10 studies, start deleting studies. Stop deleting when there are no more studies to delete or there is enough disk space for 20 studies.
OK
Cancel

3. Set the parameters according to the customer's preference.
4. Click **OK**.

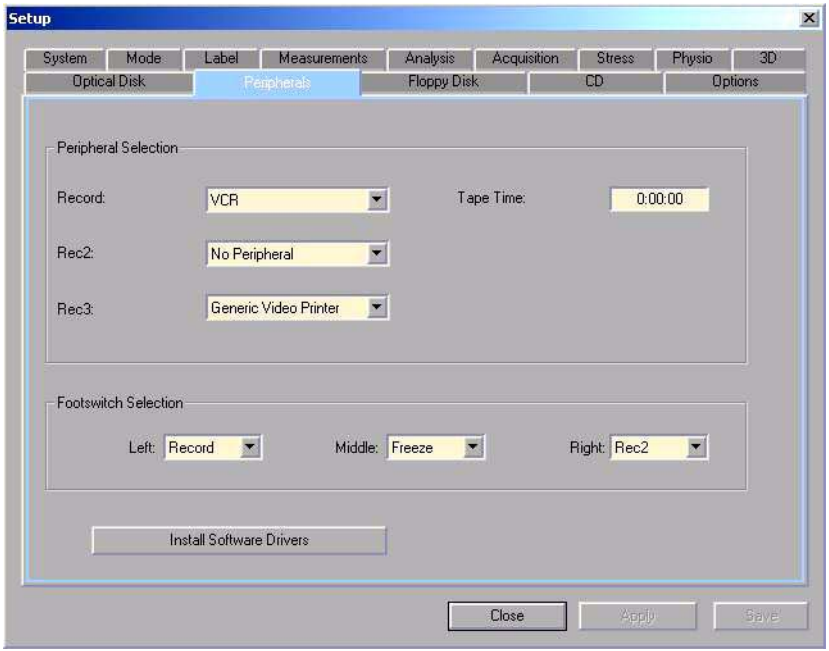
System Hardware Configuration

The following procedures configure the system for the installed peripherals and system hardware.

➤ Assigning Record Buttons

1. On the Setup window, click the **Peripherals** tab.

Figure 5-25 Setup Window (Peripherals)

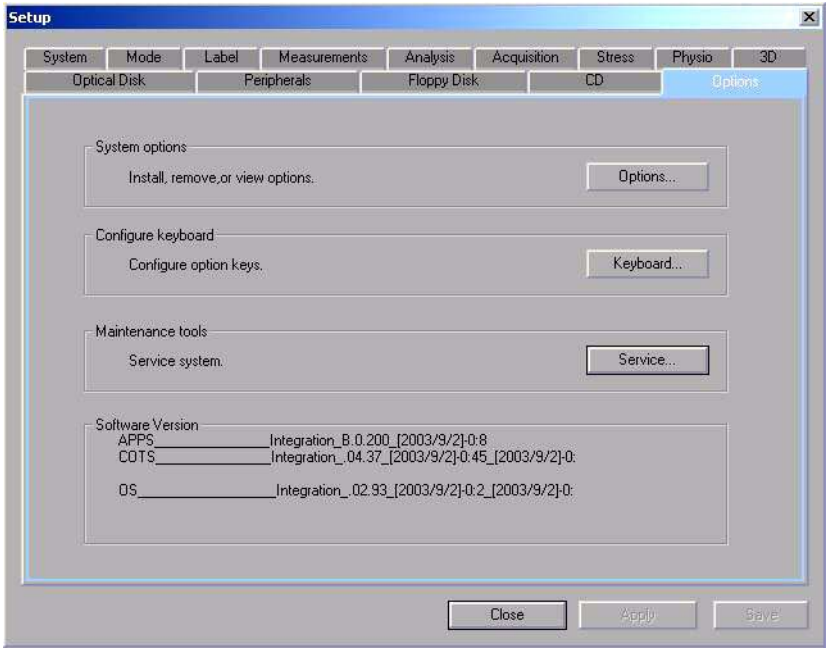


2. Select a peripheral device from the Record, Rec2, and Rec3 drop-down lists.

➤ **Assigning Option Buttons**

1. On the Setup window, click the **Options** tab.

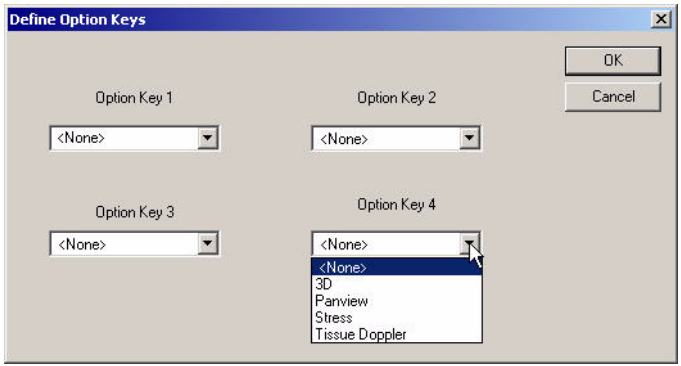
Figure 5-26 **Setup window (Options)**



2. Click **Keyboard...**.

The Define Option Keys window opens.

Figure 5-27 Define Option Keys Window



3. Click the drop-down list for each option key, and select the appropriate functions.

NOTE The drop-down lists include only those options that are part of the purchased software features.

4. Click **OK**.

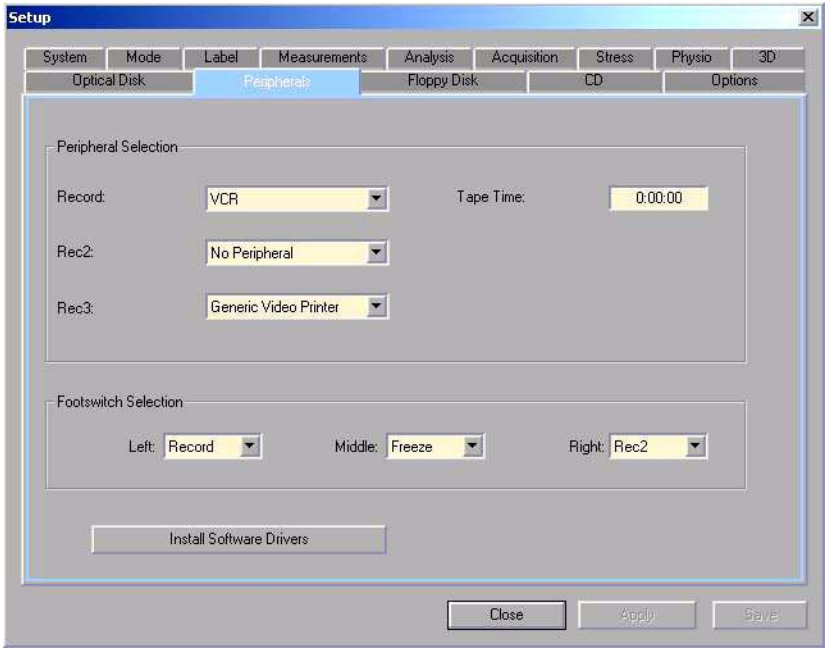
VCR Configuration

The system is configured at the factory for NTSC format. To reconfigure the system for PAL format, complete the following procedure:

➤ **Configuring the System for PAL Format**

1. On the Setup window, click the **Peripherals** tab

Figure 5-28 Setup Window (Peripherals)



2. Click **Install Software Drivers**.
   The Install Software Drivers window opens.
3. Click **Video Installation**.
4. Click **OK**.
5. Select **PAL**.
6. Click **OK**.
   The driver is reinstalled with the correct configuration. This takes about 20 seconds.

7. Click **Close** to close the Setup window.

The new setting takes effect after the system is restarted.

➤ Setting the Monitor Color Temperature

Cardiologists prefer a bluer tint to the monitor display than radiologists do. Pressing the two left monitor buttons together toggles between the two color settings.

- Setting 1 is appropriate for cardiology use.
- Setting 2 is appropriate for non-cardiology use.

To set the monitor color temperature:

1. In normal ultrasound mode, press the two left monitor buttons at the same time.
2. A window displays the current color temperature setting.
3. To change the setting, press the two left buttons again, while the current setting is displayed.

Printer Configuration

The drivers for Sony UP-D895, Sony UP-D21MD, HP940, HP1200, HP1300, and HP 5550 printers are loaded automatically. These printers are ready to use when connected to a USB port.

The following printers require additional steps after they are configured.

➤ HP940

- Reboot the system after the first time you plug the printer into it.

➤ HP1200

After you install an HP1200, perform the following procedure:

1. In the Setup window, click the **Peripherals** tab.
2. Right-click **HP1200** in one of the Record drop-down lists to select it
3. In the dialog box that appears, click **Finishing**.

4. Click **Details**.
5. Click **Send Page as Raster**.
6. Click **OK**.
7. Click **OK**.
8. Click **Close**.

Customer Training

The customer needs some instruction in maintenance and use of the system:

- Instruct the customer how to back up and restore presets (see "Creating a Backup Floppy" on page 184 and "Restoring System Options and Custom Presets" on page 189). Make a backup floppy disk of the customer's presets and configurations, and store it behind the lower enclosure's left rear door. If the software is reloaded later, the backup floppy disk lets you quickly restore settings and options.
- Explain the importance of letting the system shut down completely before disconnecting the power cord.
- Demonstrate how to clean the air filter ("Cleaning the Air Filter" on page 168), and explain the importance of the filter to system performance.
- Demonstrate how to remove and clean the trackball. (See "Cleaning the Trackball" on page 169.)
- If the system is connected to a DICOM network, show the customer the job manager (in Setup, on the System tab, click DICOM, and then click the Diagnostics tab.) Explain that the user should check the job manager at the end of each day. An empty queue indicates that all studies have been successfully transferred to the DICOM PACS.

6 Performance Tests

Overview

This section includes all test procedures for diagnosing problems with the M2540A and assuring its safe and accurate operation.

The following sections are in this section:

- "Test and Inspection Matrices" on page 111
- "Electrical Safety Tests" on page 126
- "PC Diagnostics" on page 142
- "Resident Self Tests" on page 143

Test and Inspection Matrices

The following tables indicate the tests that need to be performed on an EnVisor (M2540A) ultrasound system under various conditions.

- Table 6-1 describes what tests need to be performed following preventative maintenance (PM's), installations, and repairs.
- Table 6-2 and Table 6-3 tell when the test blocks should be performed.

Table 6-1 M2540A System Test and Inspection Matrix

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
Sv: (System Visual Inspection)	Inspect the system controls, cables, power cord, transducer(s) cables, lenses and controls, and system and transducer's physical condition. Are all of the above free from physical damage that could make the equipment unsafe?	Answer to question is "yes".	**Sv:P or Sv(sn):F (sn = last 5 digits of serial number, P= Pass and F = Fail)**
Sgc: (System Ground Continuity)	Measure the resistance between the ground pin on the system power cord and the system chassis ground.	< 200 milliOhms	**Sgc:P/x or Sgc(sn):F/x (x = ohms measured, and sn = last 5 digits of serial number, P= Pass and F = Fail)**
S: (System or Stand-alone Peripheral Safety)	Measure with safety analyzer: (w) Case (ground wire) leakage current (normal condition) (x) Case (chassis) ground resistance	w = < 300 a (UL—USA only), or < 500 µA (IEC/CSA) x = < 200 mOhms (UL/IEC/CSA)	**S:P/w/x/y/z or S:F/w/x/y/z (P = Pass, F = Fail, and w, x, y, z = uA or mOhms measured)**

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
	If ECG module is installed then do: (y) ECG Leads leakage isolation current, **sink** (mains voltage applied) (z) ECG Leads leakage current, **source** (single fault)	y = < 50 µA (UL/IEC/CSA) x = < 50 µA (UL/IEC/CSA) If test was within the above limits, the system passes, and you record the test data. See NOTE on page 120.	**NOTE:** It is not necessary to record the units of measure, only the numerical data.
Ste: (Safety—TEE and Endocavity Transducers)	Measure the leakage current of the transducer, using the test setup described in "Electrical Safety Tests" on page 126.	< 80% of system case leakage current (test result "w" from the **S** test) If transducer is within the above limits, the Transducer passes, and you record test data.	**Ste(sn):P/x** **or** **Ste(sn):F/x** **(x = µA measured and sn = last 5 digits of serial number,** **P= Pass and F = Fail)**

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

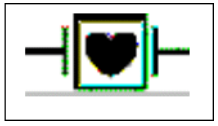
Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
Sep: Safety— Epiaortic Transducer/ Interoperative **(CF Type)** 	Measure the leakage current of the CF transducer using test setup described in "Electrical Safety Tests" on page 126. (x) Leakage current, **source** (single fault) (y) Leakage current, **sink** (mains voltage applied)	(x) < 50 µA (UL/IEC/CSA) (y) < 50 µA (UL/IEC/CSA) If transducer is within above limits, the transducer or PIU passes, and you record test data.	**Sep(sn):P/x/y or Sep(sn):F/x/y (x and y = µA measured, sn = last 5 digits of serial number, P= Pass and F= Fail)**
Ti: (All models of imaging transducers)	Are transducer and lens free from cuts, or other physical damage?	Answer to question is "yes." (If so, perform the next inspection.) (See "Important Condition:" on page 116.)	

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

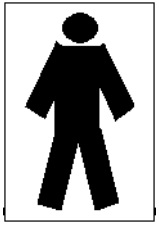
Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
	Activate the transducer. Is the transducer recognized by the system (its ID label appears on the screen) and does it image? **NOTE:** Turn the gain up to ensure that the transducer will image. Dip the transducer tip in water and verify that there is an image throughout the sector.	If all answers were "yes," the transducer passes. **Important Condition:** Perform the Sbf test if a **transthoracic** "BF" transducer passes all of the above tests, yet has *minor* physical damage which *normally* does not result in transducer replacement, but does warrant verifying electrical integrity. **Ti** will still be **Pass** (from a physical perspective). Passing or failure of the **electrical integrity** test is indicated in the **Sbf** test results.	**Ti:P** **or** **Ti:F** ***("sn" is the last 5 digits of the serial number of the transducer that failed, and P = Pass and F=Fail)***
Sbf: Safety—Transthoracic Transducer (**BF Type**) 	Only perform this test if, during the **Ti** or **Tn** test, minor damage to a transthoracic "BF" transducer indicates the need to verify electrical integrity. Measure the leakage current of the transducer using test setup described in "Electrical Safety Tests" on page 126. (x) Leakage current, **source** (single fault) (y) Leakage current, **sink** (mains voltage applied)	(x)< 500 µA (UL/IEC/CSA) (y)< 250 µA (UL/IEC/CSA) If transducer is within above limits, the transducer passes, and you record test data.	**Sbf(sn):P/x/y** **or** **Sbf(sn):F/x/y** **(x and y = uA measured, sn = last 5 digits of serial number, P = Pass and F = Fail)**

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
Tn: (all models of nonimaging transducers)	Are Transducer and lens free from cuts or other physical damage?	Answer to question is "yes." (If so, perform next inspection.) (See "Important Condition:" on page 116.)	
	Activate the transducer; is the transducer recognized by the system (its ID label is on the screen)?	Answer to question is "yes." (If so, perform next inspection.)	
	Does the spectrum move up and down with finger movement toward and away from transducer?	Answer to question is "yes." If all answers were "yes", the transducer passes. **Important Condition:** Perform the Sbf test if a **transthoracic** "BF" transducer passes all of the above tests, yet has *minor* physical damage which *normally* does not result in transducer replacement, but does warrant verifying electrical integrity. **Ti** will still be **Pass** (from a physical perspective). Passing or failure of the **electrical integrity** test is indicated in the **Sbf** test results.	**Tn:P** **or** **Tn(sn):F** ***("sn" is the last 5 digits of the serial number of the transducer that failed, and P = Pass and F = Fail)***

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
P: (Printers, all models)	Using the system controls, make a test print of the initial imaging screen: Compare the print to the screen. Does all of the information presented on the screen and print match?	Answer to question is "yes." (If so, perform next inspection.)	
	Are the printout characters in focus?	Answer to question is "yes." (If so, perform next inspection.)	
	Do all of the printer controls operate as intended?	Answer to question is "yes." (If so, perform next inspection.)	
	Inspect the printout. Is it free from scratches, missing pixels, lines, indications of noise, or any other disfigurement that would alter the image?	Answer to question is "yes." If all answers are "yes", the printer passes.	**P:P** **or** **P:F** **(P = Pass and F = Fail)**
V: (VCRs, all models)	On the ultrasound system, tape at least 30 seconds of any live color image and 30 seconds of any black and white image with Audio:		

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
	Did all of the information that was showing on the system screen record on the video tape?	Answer to question is "yes." (If so, perform next inspection.)	
	During playback, was the image in focus and easy to view without distortion (no excess snow, jitter, or noise)?	Answer to question is "yes." (If so, perform next inspection.)	
	Were all of the colors in playback shown on the color bar?	Answer to question is "yes." (If so, perform next inspection.)	
	Do all of the VCR control functions operate properly? (Start/Stop/FF/Rew/Reset/Search, and so on)	Answer to question is "yes." (If so, perform next inspection).	
	Can playback audio be heard on speakers?	Answer to question is "yes." If all answers were yes, the VCR passes.	**V:P or V:F (P = Pass and F = Fail)**
Xp: (PC)	When the system is powered on, did the system arrive at initial imaging screen without reporting errors?	Answer to question is "yes." (If so, perform next inspection.)	

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
	Do all of the devices in, or connected to, the PC work as intended? (keyboard, trackball, Floppy disk, CD, MOD)	Answer to question is "yes." If answer to this and previous question is "yes", PC test passes.	**Xp:P** **or** **Xp:F** **(P=Pass and F = Fail)**
X: (software)	In the SETUP window, click the **Options** tab. Then click **Options** and view the Software Revision number in the title bar of the dialog box. Is the software revision number correct?	If answer to question is "yes", software test passes.	**X:P** **or** **X:F** **(P=Pass and F = Fail)**
E: (E-Box, Power Supply)	Run RST "Extended Test." Did all tests pass?	Answer to question is "ye"s.	**E:P** **or** **E:F** **(P=Pass and F=Fail)**
C: (**Cart:** power cord, wheels, cart, keyboard, monitor)	Are the power cord and on/off switch in good physical condition and working properly?	Answer to question is "ye"s. (If so, perform next inspection.)	

Table 6-1 M2540A System Test and Inspection Matrix (Continued)

Test Block Name (or Symbol)	Test or Inspection to Perform	Expected Test Results	What to Record on Service Record
	Are all active components—the wheels, brakes, rear door, peripheral strap, monitor swivel, and keyboard up/down/swivel working as intended?	Answer to question is "yes." If both answers are yes, the cart passes.	
	Do all of the user interface controls work as intended? (keyboard, trackball, panel light, monitor controls, and speakers)	Answer to question is "yes." (if so, perform the next inspection)	**C:P** **or** **C:F** **(P = Pass, and F=Fail)**

NOTE A test can fail. If this happens, correct the problem, and retest. If test passes, put "P" or "Pass" on the service record. If the test still fails, then indicate "F" or "Fail" (include the last 5 digits of the serial number of the device that failed if the test results box indicates a serial number is needed). If the problem cannot be fixed, or if the customer refuses a repair, explain in the comments section of the service record why the product was still in the Fail condition at the end of the service event.

Table 6-2 When to Perform Tests—Summary

Test Name	Test Code	PMs	Install/ Upgrade	Other Service Events	Comments
Safety—Visual Inspection	**Sv:P**	Yes	Yes	See Table 6-3.	Not required on software-only upgrades.
Safety—Ground Continuity	**Sgc(sn):P/x**	**No**	Yes	See Table 6-3.	Not required on software-only upgrades.
Safety—System	**S:P/w/x/y/z**	Yes	**No**	See Table 6-3.	Not required on installs and upgrades.
Safety—TEE and Endocavity	**Ste(sn):P/x**	Yes	**No**	See Table 6-3.	
Safety-Epiaortic/ Interoperative (CF)	**Sep(sn):P/x/y**	Yes	**No**	See Table 6-3.	
Imaging Transducers	**Ti:P**	Yes	Yes	See Table 6-3.	
Safety—Transthoracic (BF)	**Sbf(sn):P/x/y**	**see comment**	No	See Table 6-3.	Test only if visual inspection results in questionable electrical integrity.
Non-Imaging Transducers	**Tn:P**	Yes	Yes	See Table 6-3.	
Printers	**P:P**	Yes	Yes	See Table 6-3.	
VCRs	**V:P**	Yes	Yes	See Table 6-3.	
PC	**Xp:P**	Yes	Yes	See Table 6-3.	
Software	**X:P**	**No**	Yes	See Table 6-3.	Run only after loading software.

Table 6-2 When to Perform Tests—Summary (Continued)

E-Box	**E:P**	Yes	Yes	See Table 6-3.	
Cart	**C:P**	Yes	Yes	See Table 6-3.	

Table 6-3 When to Perform Tests—Details

Test Block Name (Symbol)	After a PM	After an Install or Upgrade	Other Situations Requiring Testing
Sv: (System Visual Inspection)	**Yes**	**Yes**	In any situation where the service engineer or customer suspects that the system or transducers may have sustained physical damage.
Sgc: (System Ground Continuity)	**No**	**Yes**	• Whenever a component was changed that is part of the main power circuitry: - Power cord - Power supply - Power cable from rear of cart to power supply • In any situation where the CE (or customer) suspects that the electrical safety of the system may have been compromised. **NOTE:** System Ground Continuity is not required after software-only installations or upgrades.

Table 6-3 When to Perform Tests—Details (Continued)

S: (Safety—System or Stand-alone Peripherals)	**Yes**	**No**	• In any situation where the CE (or customer) suspects that the electrical safety of the system may have been compromised. • Whenever the ECG/Physio board is changed. • System Safety *not* required after software-only installation or upgrades.
Ste: (Safety—TEE and Endocavity Transducers)	**Yes**	**No**	In any situation where the CE suspects that the electrical safety of the transducer may have been compromised.
Sep: (Safety—Epiaortic/ Interoperative Transducers—CF Type)	**Yes**	**No**	In any situation where the CE suspects that the electrical safety of the transducer may have been compromised.
Ti: (Imaging Transducers)	**Yes**	**Yes** See NOTE on **page 125**.	Whenever just the imaging transducer has been serviced.
Sbf: (Safety—Transthoracic BF type transducers)	(See the Other Situations Requiring Testing column)	**No**	This test is only performed if, during the visual inspection of a transthoracic "BF" type transducer, a physical defect is noted that could compromise the electrical integrity of the transducer. For example: A small crack or hole in the lens or body of the transducer is present.

Table 6-3 When to Perform Tests—Details (Continued)

Tn: (Non-Imaging Transducers)	**Yes**	**Yes** See NOTE on page 125.	Whenever just the nonimaging transducer has been serviced.
P: (Printers)	**Yes**	**Yes**	• Whenever any system or stand-alone printer has been serviced. • Whenever any circuitry or cables that control or send signals to a printer have been serviced.
V: (VCRs)	**Yes**	**Yes**	• Whenever any system or stand-alone VCR has been serviced. • Whenever any circuitry or cables that control signals to a VCR have been serviced.
Xp: (PC)	**Yes**	**Yes**	• Whenever the PC or any of its components has been serviced. • Whenever any cables connected to the PC have been serviced.
X: (Software)	**No**	**Yes**	This test is performed during an install or a repair service only if system software was loaded. This test ensures that you have loaded the correct software version.

Table 6-3 When to Perform Tests—Details (Continued)

E: (E-Box, Power Supply)	**Yes**	**Yes**	• Whenever any component in E-Box or power supply has been serviced. • Whenever any cable attached to the E-Box or power supply has been serviced. • During preventive maintenance or if configuration is lost, test the battery.
C: (Cart)	**Yes**	**Yes**	• Whenever any part on the cart has been serviced (a part that is not a part of one of the other test blocks). For example: When the power cord, wheels, cart, keyboard, monitor, rear door, monitor twivel, or the side panels are serviced. **NOTE:** Stand-alone, nonimaging and imaging transducers that are sent to a customer by themselves (not with a system), do not require installation and therefore do not require this test.

Electrical Safety Tests

The tests described on the following pages are part of a comprehensive preventive maintenance program. They detect abnormalities that could prove dangerous to patient or operator.

NOTES

- The system power supply is a self-contained unit that is safety-tested by its manufacturer. No further safety testing is needed when the power supply is installed or replaced.
- After any service or maintenance, perform the required tests to assure that system safety and functions are not compromised.
- Inspect power cords frequently, especially at their ends.

This section describes the following safety tests:

- The Chassis to Ground Resistance test checks the entire system for electrical resistance between the chassis and ground. See "Chassis to Ground Resistance Test" on page 127.
- The Ground Wire Leakage Current test checks the entire system for leakage on ground leads. See "Ground Wire Leakage Current Test" on page 129.
- The ECG Lead Leakage Current test checks ECG leads connected to the optional Physio module for electrical leakage. See "ECG Lead Leakage Current Test (Source)" on page 131.
- The ECG Lead Isolation Leakage test checks ECG leads by applying voltage from the mains to the leads, to assure that the system is isolated from such voltages. See "ECG Lead Isolation Leakage Current Test" on page 133.
- The Transducer Leakage Current test checks a transducer for electrical leakage while it is connected to the ultrasound system. The system sends normal operating voltages to the transducer, which is tested for leakage. See "Transducer Leakage Current Test Procedure" on page 137.

- The Transducer Isolation Leakage Current test applies mains voltage to the leads to check a transducer for electrical leakage. See "Transducer Isolation Leakage Current Test" on page 139.

All tests can be performed using commercially available safety analyzer test equipment. Basic measurements can be performed with multifunction instruments like the HP 3469A multimeter.

NOTE These procedures require a safety analyzer. Routinely use a safety analyzer as a final step in any repair or upgrade, to maintain agency approved status. The safety analyzer is also useful in detecting abnormalities of line voltage, grounding, and total current loads. Follow the instructions of the analyzer manufacturer.

The limits referenced in these tests are prescribed by UL, CSA, and IEC. Local regulations may require additional tests.

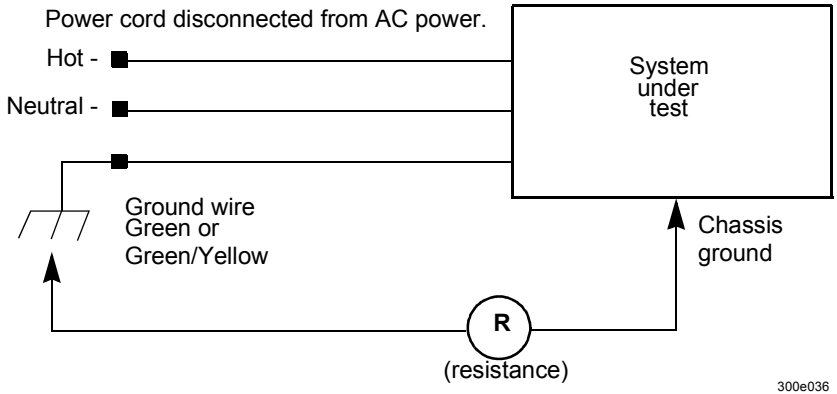
Chassis to Ground Resistance Test

This test checks the entire system for electrical resistance between the chassis and ground. Figure 6-1 on page 128 shows the basic electrical concept of the ground resistance test. Use a safety analyzer and complete the procedure that follows the figure.

WARNING

Some users routinely perform a safety-earth or ground-bonding test at currents in excess of 10 amps. Test currents in excess of 1 amp will likely exceed the impedance limit specification, and can damage the RFI protection finger contacts. Exposed metal on the transducer assembly, including the connector, are for RFI and are not safety grounds.

Figure 6-1 Chassis to Ground Resistance Test Diagram



LIMIT: UL, CSA and IEC:**R** = 200 milliohms maximum

➤ Chassis to Ground Resistance Test Procedure

To test the system for resistance between chassis and ground:

1. Inspect the power cord for cracks and wear.
2. Set the mode on the analyzer to measure resistance in the power cord.
3. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
4. Make the appropriate connections between the analyzer and the ground lug on the ultrasound system's I/O panel.
5. Read chassis ground resistance in milliohms. Flex the ultrasound power cord during the test to detect intermittent changes in resistance value.

6. Record the highest resistance value measured in step 5. Check that the highest resistance value is within the limit specified in Figure 6-1 on page 128.

NOTE If the reading exceeds the specified limit, check the power cord and the associated primary wiring.

A comprehensive ground impedance measurement can be performed using the safety analyzer. The impedance test drives a load current through the ground wire while measuring the AC voltage drop across the entire length of the power cord and to the system chassis. The reading will be in milliohms.

Ground Wire Leakage Current Test

This test checks the entire system for leakage on chassis ground wires. Figure 6-2 on page 130 shows the basic electrical concept of the test. Use a safety analyzer and complete the procedure that follows the figure.

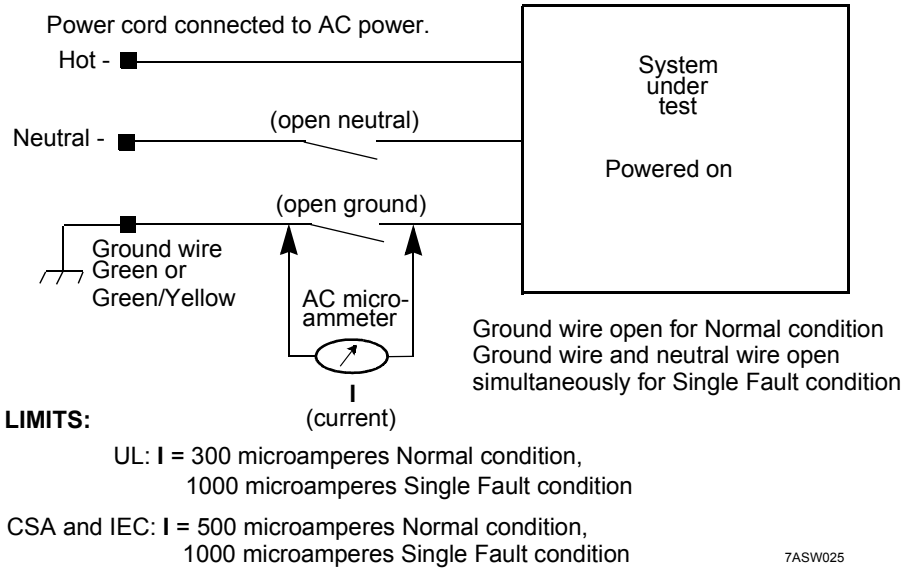
CAUTION

If the safety analyzer is used for an extended period, it may be damaged by the high current draw of the system.

WARNING

This test can be hazardous. Avoid any contact with line voltage. Any time during the test that the ground connection is open, do not touch the M2540A chassis or the patient cable.

Figure 6-2 Ground Wire Leakage Current Test Diagram



➤ Ground Wire Leakage Current Test Procedure

To test the system's ground wiring for leakage:

1. Set the mode on the analyzer to detect leakage.
2. Plug the analyzer into an available wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer. Turn on the ultrasound system's power by starting the internal PC.
3. Take ground wire leakage current measurements in an open ground condition, with both normal and reverse polarity. Record the highest value, and compare it to the limit specified for Normal condition in Figure 6-2 on page 130.

4. Take ground wire leakage current measurements in an open ground and open neutral condition, with both normal and reverse polarity. Record the highest value, and compare it to the limit specified for Single Fault condition in Figure 6-2 on page 130.

A reading higher than acceptable limits can indicate a problem with the power cord, with its associated connections, or with the power transformer.

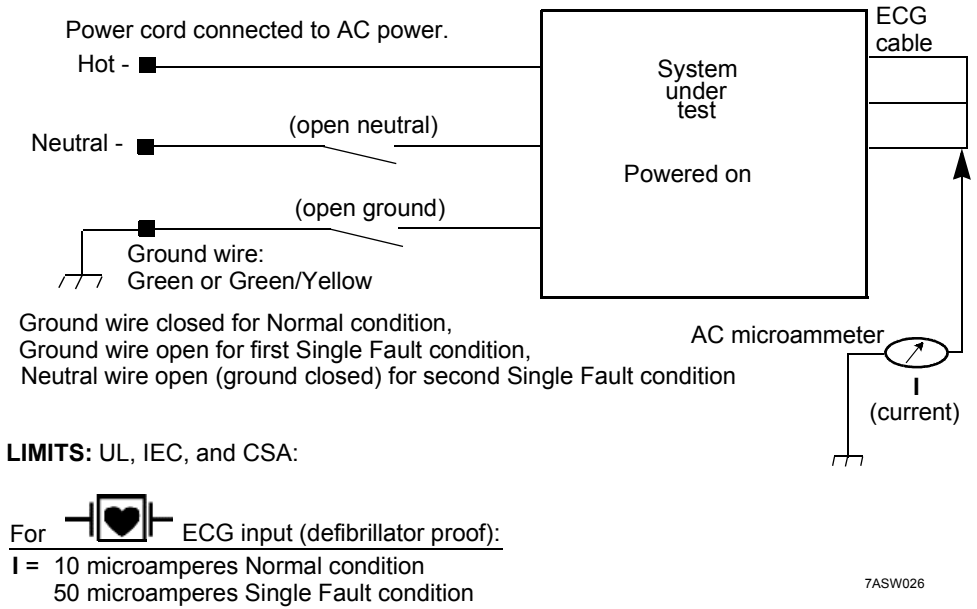
ECG Lead Leakage Current Test (Source)

This test checks ECG leads connected to the optional Physio module for electrical leakage. Figure 6-3 on page 132 shows the basic electrical concept of the ECG Lead Leakage Current test. Use a safety analyzer and complete the procedure that follows the figure.

WARNING

This test can be hazardous. Avoid any contact with line voltage. Any time during the test that the ground connection is open, do not touch the M2540A chassis or the patient cable.

Figure 6-3 ECG Lead Leakage Current Test Diagram



➤ ECG Lead Leakage Current Test Procedure

1. Set the analyzer to test ECG leads.
2. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
3. Turn on the ultrasound system by starting its internal PC.
4. Connect all ECG leads to the ultrasound system and to the appropriate jacks on the analyzer.

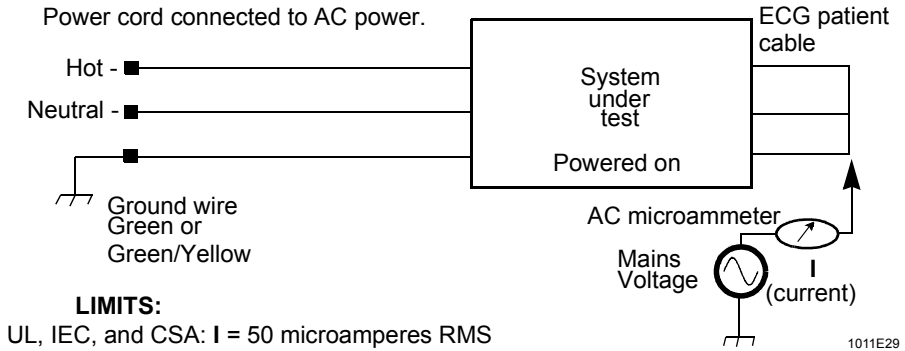
5. Take ECG lead leakage current measurements with both normal and reverse polarity. Check that the highest value is within the limit specified for Normal condition in Figure 6-3 on page 132.
6. Take ECG lead leakage current measurements in open ground condition, with both normal and reverse polarity. Check that the highest value is within the limit specified for Single Fault condition in Figure 6-3. Write down the highest value; this is the value for the first Single Fault condition.
7. Take ECG lead leakage current measurements in open neutral condition, with both normal and reverse polarity. Check that the highest value is within the limit specified for Single Fault condition in Figure 6-3. Write down the highest value; this is the value for the second Single Fault condition.
8. Record the highest current value measured in step 6 and step 7. Check that the highest value is within the limit specified for Single Fault condition in Figure 6-3.

Failure to meet the specified limits may indicate a fault with the isolation of the Physio module.

ECG Lead Isolation Leakage Current Test

This test checks ECG leads by applying voltage from the mains to the ECG leads, to check that the system is isolated from such voltages. Figure 6-4 on page 134 shows the basic electrical concept of the ECG Lead Isolation Leakage Current test. Use a safety analyzer and complete the procedure that follows the figure.

Figure 6-4 **ECG Lead Isolation Leakage Current Test Diagram**



WARNING

This test is hazardous. It applies line voltage to the ECG leads. Avoid accidental contact with the line voltage. Do not touch the chassis or the ECG cable while performing the test. Keep the ECG cable at least 20 cm (8 in) from any grounded or conductive surfaces.

NOTE During the isolation test, select only *normal* polarity. Do *not* impose open ground or open neutral conditions.

➤ ECG Lead Isolation Leakage Current Test Procedure

1. Set the analyzer's mode to test ECG isolation.
2. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
3. Turn on the ultrasound system by starting its internal PC.

4. Connect ECG leads to the ultrasound system, but *do not* connect the ECG leads to the analyzer yet.
5. In normal polarity, perform a lead isolation test. Record the reading in microamperes. This reading is the correction factor used in step 7.
6. Connect all ECG leads to the appropriate jacks on the analyzer and perform a lead isolation test. Record the reading in microamperes.
7. Subtract the step 5 correction factor from the step 6 reading to get an accurate isolation leakage measurement. Record this value. Check that the value is within the limit specified in Figure 6-4 on page 134.

NOTE Some analyzers do not require subtracting the correction factor from the lead isolation reading. For more information, see the analyzer's documentation.

Transducer Tests

This section describes two electrical leakage current tests for transducers. To ensure patient safety, it is very important to verify the integrity of the insulating layers of all transducers.

When you perform the safety tests, use saline solution in a container as a conductive medium (see Figure 4-5 on page 63). The solution penetrates any cracks or holes in the transducer insulation and provides an electrical path between the submerged lead wire and the inner transducer shield.

"Transducer Safety Testing: Test Setup and Theory" on page 62 includes supporting information about the transducer tests. This is supplemental information, and is not required to complete the tests.

NOTE Before proceeding with any transducer test, thoroughly inspect the transducer. If the transducer is a TEE, check that its steering controls are working properly.

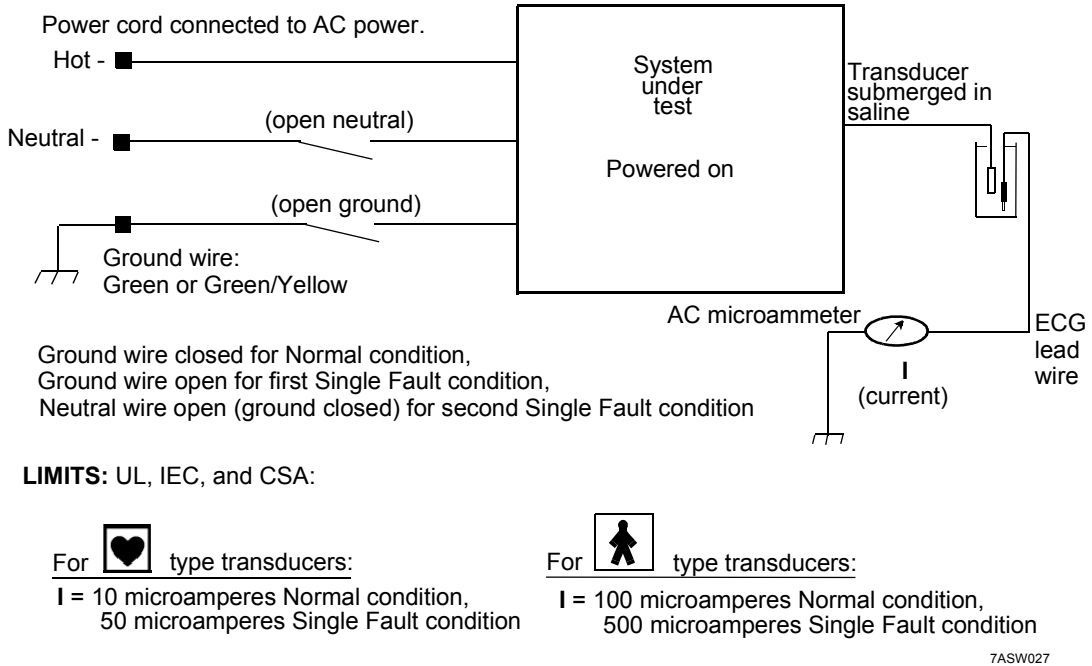
The following tools are required for transducer safety tests:

- Safety analyzer
- Saline holder
- ECG lead wire
- Saline solution. If saline is not available, mix 27 grams of table salt in 3 liters of tap water.

Transducer Leakage Current Test (Source)

This test checks a transducer for electrical leakage while it is connected to the ultrasound system. The system sends normal operating voltages to the transducer, and leakage is measured using a safety analyzer. Figure 6-5 on page 137 shows the basic electrical concept of the Transducer Leakage Current test. Complete the procedure that follows the figure.

Figure 6-5 Transducer Leakage Current Test Diagram



➤ Transducer Leakage Current Test Procedure

1. Set the analyzer mode to test ECG leads.
2. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
3. Turn on the ultrasound system by starting its internal PC.
4. Plug the transducer to be tested into the ultrasound system. Connect an ECG lead wire to the appropriate jack on the analyzer.

5. Fill a test container with enough saline to completely cover the appropriate parts of the transducer. Insert the exposed end of the ECG lead into the saline, and carefully insert the transducer:
   - For trashe patient: 100 cm (39.4 in) for adult TEE, 60 cm (23.6 in) for pediatric TEE.

CAUTION

When submerging a TEE transducer, be careful to not submerge its control handle or allow saline to contact its control handle. Liquid inside the control handle causes corrosion and failure.

6. Set the analyzer to read leakage current in microamperes.
7. Read the current in both normal and reverse polarity, and record the highest value. Check that the highest value is within the limit specified for Normal condition in Figure 6-5 on page 137. (Match the transducer type symbol on the transducer connector or cable with the symbol in the figure.)
8. Read the current with an open ground condition imposed, in both normal and reverse polarity. Write down the highest value; this is the value for the first Single Fault condition.
9. Read the current with an open neutral condition imposed, in both normal and reverse polarity. Write down the highest value; this is the value for the second Single Fault condition.
10. Check that the highest current value measured in step 8 and step 9 is within the limit specified for Single Fault condition in Figure 6-5.

    Values exceeding the limits may indicate a fault in the transducer housing or the cable sheath. To locate a fault precisely, repeat the measurement while slowly inserting the transducer into the saline. The aberrant reading appears when the fault in the cable enters the saline.

NOTE TEE and endocavity transducers have a grounded jacket just under the outer plastic skin of the cable. Their leakage currents can measure within the specified limits even if there is a fault in the outer skin. Step 11 tests for this condition.

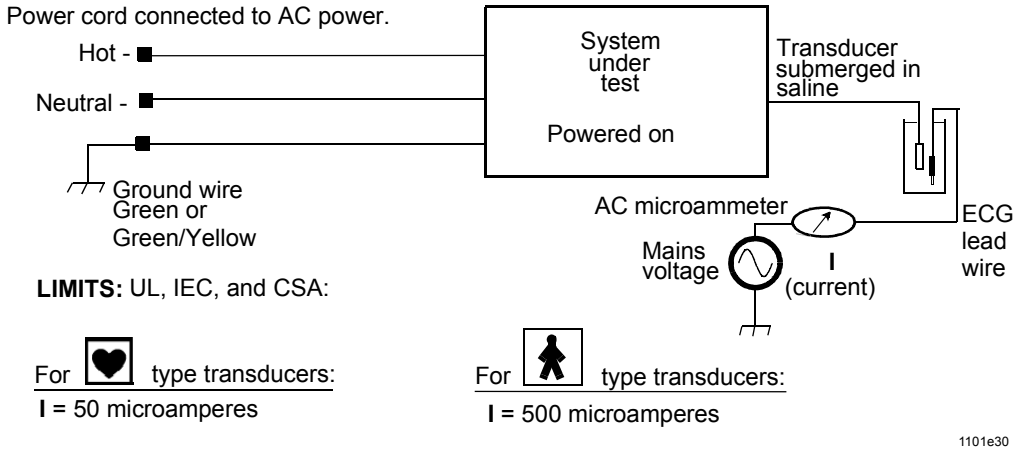
11. In normal polarity with an open ground condition imposed, measure ground wire leakage (see "Ground Wire Leakage Current Test" on page 129). Compare this to the highest value for transducer leakage current, Single Fault condition obtained in step 10.

    If the transducer leakage is greater than 80% of the chassis leakage, there is a fault in the transducer. To locate the fault, slowly insert the transducer in the saline, as in step 10.

Transducer Isolation Leakage Current Test

Figure 6-6 on page 140 shows the basic electrical concept of the Transducer Isolation Leakage Current test. The transducer is submerged in a container of saline solution. Mains AC voltage is introduced into the saline solution, and leakage current in the transducer is measured using a safety analyzer. Complete the procedure that follows the figure.

Figure 6-6 Transducer Isolation Leakage Current Test Diagram



WARNING

This test is hazardous. It applies line voltage to the ECG and transducer cables. Avoid accidental contact with the line voltage. Do not touch the chassis or the ECG or transducer cables while performing the test. Keep the ECG and transducer cables at least 20 cm (8 in) from any grounded or conductive surfaces.

NOTE During the isolation test, select only *normal* polarity. Do *not* impose open ground or open neutral conditions.

➤ Transducer Isolation Leakage Current Test Procedure

1. Set the analyzer to test ECG.
2. Plug the analyzer into an available AC wall outlet. Plug the ultrasound system power plug into the test receptacle on the analyzer.
3. Turn on the ultrasound system by starting its internal PC.
4. Plug the transducer to be tested into the ultrasound system.
5. Fill a test container with enough saline to completely cover the appropriate parts of the transducer.
6. Insert the exposed end of the ECG lead wire into the saline, and then carefully insert the transducer:
    - For transthoracic and endocavity transducers, submerge the head and 5 cm of the cable. Be careful not to submerge the connector.
    - For TEE transducers, submerge all of the flexible shaft that would normally enter the body of the patient: 100 cm for adult TEE, 60 cm for pediatric TEE.

CAUTION

When submerging a TEE transducer, be careful to not submerge its control handle or allow saline to contact its control handle. Liquid inside the control handle causes corrosion and failure.

7. Measure the isolation leakage current of the transducer. Record the value, and check that it is within the limit specified in Figure 6-6 on page 140.

PC Diagnostics

PC problems can often be diagnosed using the IBM Drive Fitness test. For detailed information about the test, see the IBM web site.

IBM Drive Fitness Test

➤ **Creating a DFT Bootable Floppy Disk**

1. Download the bootable version of the DFT setup program from the IBM web site into a temporary directory on your PC.
2. Click **Start**, and then click **Run**.
3. Click the **Browse** button to locate the setup program.
4. Click the filename, and then click **Open**.
5. Click **OK** to run the setup program.
6. Insert a blank formatted 1.44 MB floppy disk when prompted.

➤ **Using the Drive Fitness Test to Test PC Functions**

1. Change the VGA display height adjustment to show the whole screen. See "Adjusting VGA Vertical Size" on page 164.
2. Insert the DFT disk into the floppy disk drive.
3. As the system boots up, press the **Mic** key repeatedly, until the **Please Select Boot Device:** screen opens.
4. In the **Please select boot device:** screen, ensure that **Removable Dev.** is highlighted.
5. Press **Return**.

   The system continues to reboot from the floppy disk
6. Select ATA support.
7. Follow the on-screen instructions.

NOTE Ignore the error messages about missing SCSI disk controllers.

8. When DFT testing is complete, ensure the boot sequence is set to the CD-ROM drive as the first device in the BIOS. (See "Changing the Boot Sequence" on page 166.)

Resident Self Tests

The M2540A Resident Self Tests (RST) are a suite of tests that verify system hardware, using no external instrumentation.

The RST suite consists of tests for custom M2540A hardware and software. The Resident Self Tests also exercise individual subsystems such as the acoustic processor and the beam former processor.

The stand-alone RST application provides access to all the tests. RST also provides information on hardware and software, and service information on the ultrasound system. System information, test pass and fail results, and errors can be viewed, saved, and printed by the RST application.

Availability

The RST application is available whenever the ultrasound application is running. You can also start RST as the system powers up. When it starts, the RST application stops the main ultrasound application.

Logging On

To start the RST application, see "Starting the RST Application" on page 149. The RST application opens with a logon window, which asks you to enter a user name and a password. The logon window also includes a check box that skips the logon dialog box the next time the RST application is starts. Only service personnel can enable that option, and it only applies for 24 hours. After 24 hours, the logon dialog appears at startup, even if the option is selected.

Customers or service personnel who log on with a valid user name and password can create and modify service log entries. See "Using the Service Log" on page 161.

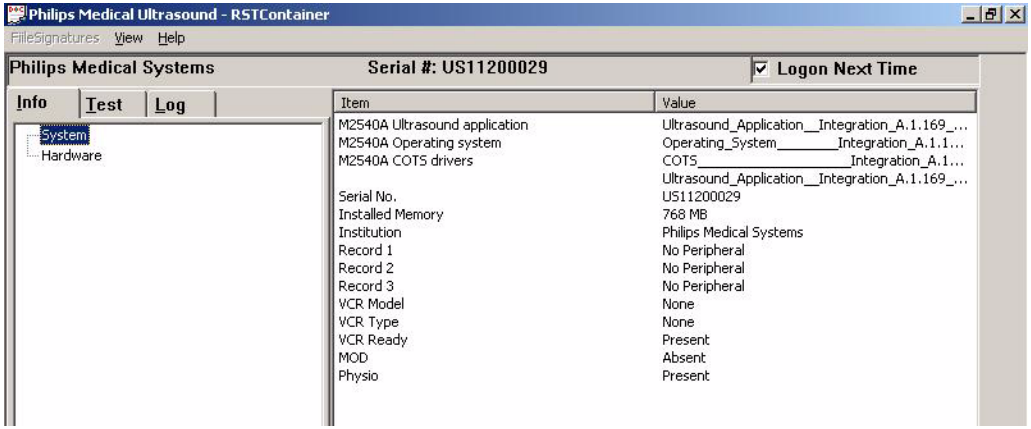
If the customer has purchased the RST option, logging on is not required.

User Interface

You can control the RST software by using the system control panel's keyboard and trackball. On the system control panel, the two keys just above the trackball perform the functions of mouse buttons. The **Enter** key acts as a left mouse button, and the **Select** key acts as a right mouse button.

Figure 6-7 shows the RST window.

Figure 6-7 RST Window



A tab view is on the left side of the RST window. On each tab is tree control that displays a hierarchy of supported functions. A *list view* is on the right side. The list view displays information related to items selected in a tree control.

There are three tabs in the RST window:

- The **Info** tab shows software, hardware, and system information. See "Information Types" on page 145.
- The **Test** tab invokes various test modes and displays test status and results. See "Tests" on page 147.
- The **Log** tab displays errors and test parameter data in the event viewer and displays service log entries in the service log. See "Viewing Error Logs" on page 154. There is also a service log on the **Log** tab, for service personnel to record information about the system. See "Using the Service Log" on page 161.

Information Types

The RST application provides information on the hardware and the software of the ultrasound system. You can select the Info tab and choose specific information types in the tree control. Choosing a tree item and pressing the **Select** key opens a drop-down list that contains Save Info and Print Info functions. Information can be saved to a text file or printed on a connected plain paper printer.

System Information

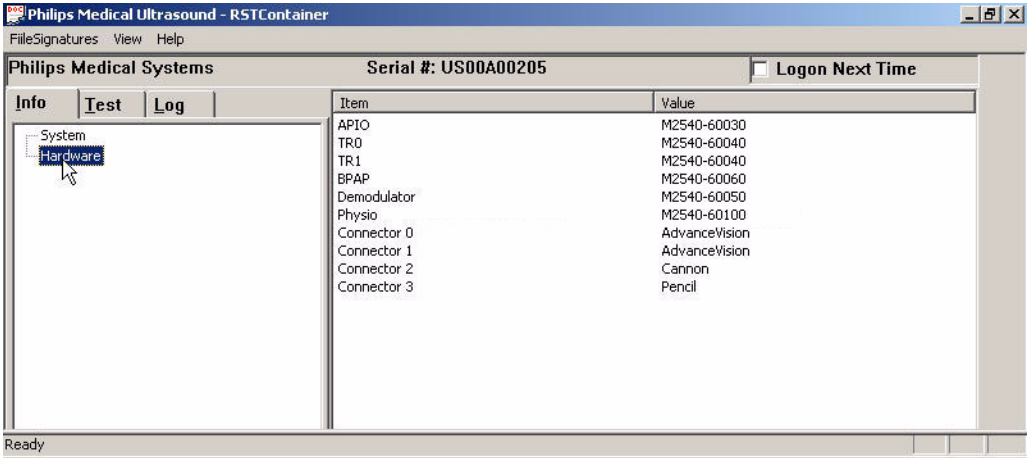
The RST application provides system information that includes the system serial number, the institution name, installed software and hardware options, and installed peripherals. Figure 6-7 on page 144 illustrates this display.

The software information provided includes the revision number and the revision date and time of the operating system, the main ultrasound application, and the common off-the-shelf (COTS) software.

Hardware Information

The hardware information provided includes information about the custom M2540A boards and transducer connector modules, identified as shown in the Figure 6-8.

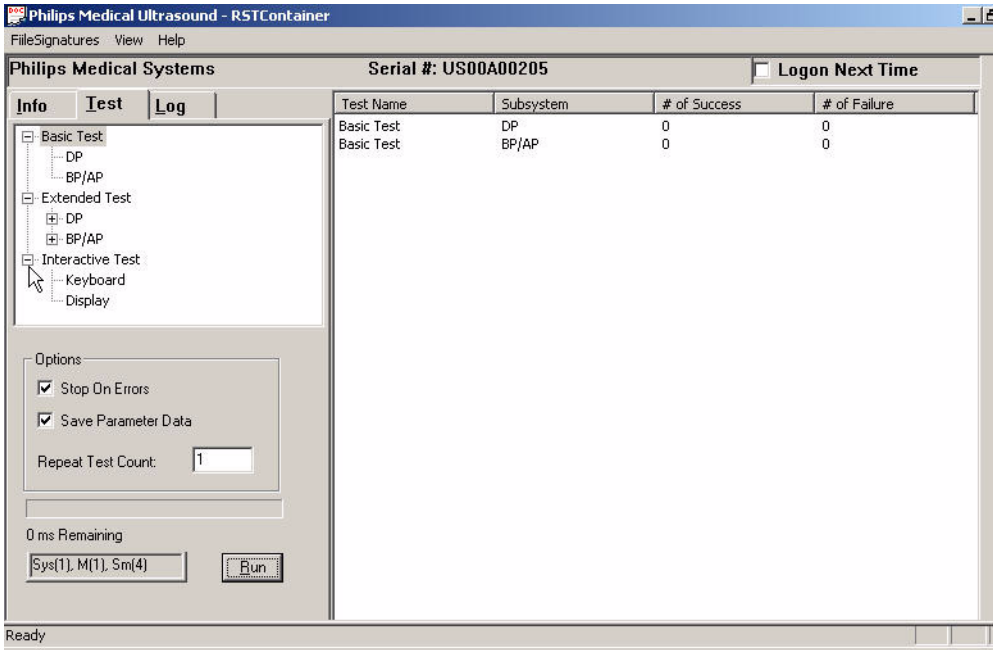
Figure 6-8 Hardware Information Display



NOTE Figure 6-8 shows an example. The connector information displayed depends on the connector modules installed.

Tests Figure 6-9 shows the RST Test display.

Figure 6-9 RST Test Display



Available Tests

The following tests are available when you log on using a valid service name and password:

- **Basic Test**: A basic test of custom M2540A hardware. The basic test executes in less than 5 minutes. The test requires no operator interaction while executing. For instructions on running basic tests, see "Running a Basic Test" on page 150.

- **Extended Test**: This is a comprehensive test of M2540A hardware. The test requires no operator interaction while it executes. The test verifies detailed system operation with fault isolation to the board level. This test reports only failures that adversely impact system performance. For instructions on running extended tests, see "Running an Extended Test" on page 151.
- **Interactive Test:** These tests verify operation of the system's controls, and require your participation. Included are tests of the display and system control panel. For instructions on running interactive tests, see "Running an Interactive Test" on page 154.

Testing Options

The left panel under the RST Test tab contains three testing options and the **Run** button that begins a selected test. When an interactive test begins, the **Run** button is grayed out.

NOTE The RST tests do not execute properly when a transducer is connected to the system. Disconnect all transducers before beginning any RST testing.

The three test options are:

- **Stop On Errors** stops all tests when an error occurs. If this option is not enabled, the selected tests run until completed. Any errors occurring during the tests are recorded in the error log.
- **Save Parameter Data** saves the measured test parameters.
- **Repeat Test Count** defines the number of times tests are repeated. The default is one. A value of zero runs tests continuously.

Test Results

The test results are shown in the list view on the right side of the RST window. The display shows the name of each test, the components tested, and the number of times the component passed and failed the test.

To view details of the test results:

1. Click the **Log** tab.
2. Select the information type from the Event Viewer tree.

   For information on errors generated during tests, see "RST Test Log" on page 156.

   When the tests are finished, the following message appears:

3. Click **OK**.

Service Log

You can enter notes in the service log section of the event viewer, to record service procedures you perform or problems you encounter. See "Using the Service Log" on page 161.

➤ Starting the RST Application

You can start the RST application while the ultrasound application is running. The procedure is the same in both cases.

To start the RST application while the ultrasound application is running:

- Press the key combination **Ctrl+Alt+R**.

To start the RST application during system boot-up:

- Press the key combination **Ctrl+Alt+R** while the ultrasound splash screen is on the display.

When it starts, the RST application closes the ultrasound application.

➤ Closing the RST Application

You can close the RST application by using either of the following two methods:

- Click the **Close** button at the upper right corner of the RST window.
- Press the **Alt** and **Report** keys simultaneously.

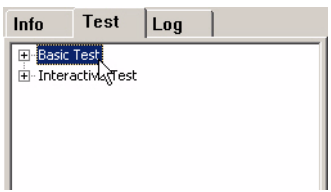
When the RST application closes, a window asks if you want to reboot.

➤ Running a Basic Test

The basic test checks custom M2540A hardware. The basic test executes in less than 5 minutes and requires no operator interaction while executing.

To run a basic test:

1. Start the RST application. See "Starting the RST Application" on page 149.
2. Log on using a valid service name and password.
3. Click the **Test** tab in the main RST window.
4. Click **Basic Test** in the tree view.



5. To run the test a specific number of times, enter the number in the **Repeat Test Count:** field. To run the test continuously, enter zero in the field.
6. Click **Run**. Testing begins.
7. When the testing is done, click **OK** in the message box.

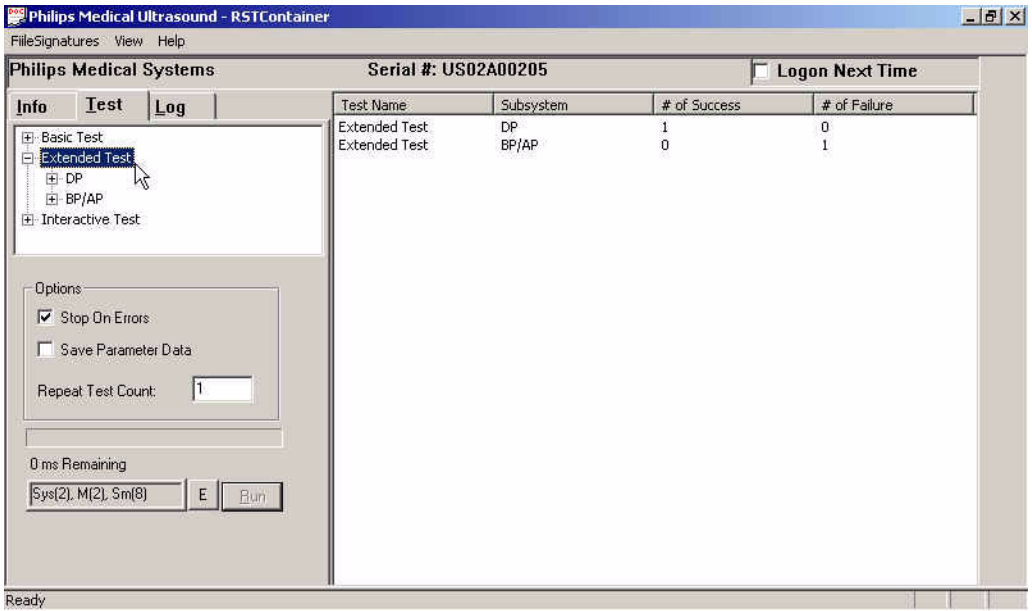
➤ Running an Extended Test

The extended tests check the system's hardware to the board level, and do not require your participation after they are started.

To run an extended test:

1. Start the **RST** application. See "Starting the RST Application" on page 149.
2. Log on using a valid service name and password.
3. Click the **Test** tab in the main RST window.
4. Click **Extended Test** in the tree view, to show the available extended tests (Figure 6-10).

Figure 6-10 RST Extended Tests

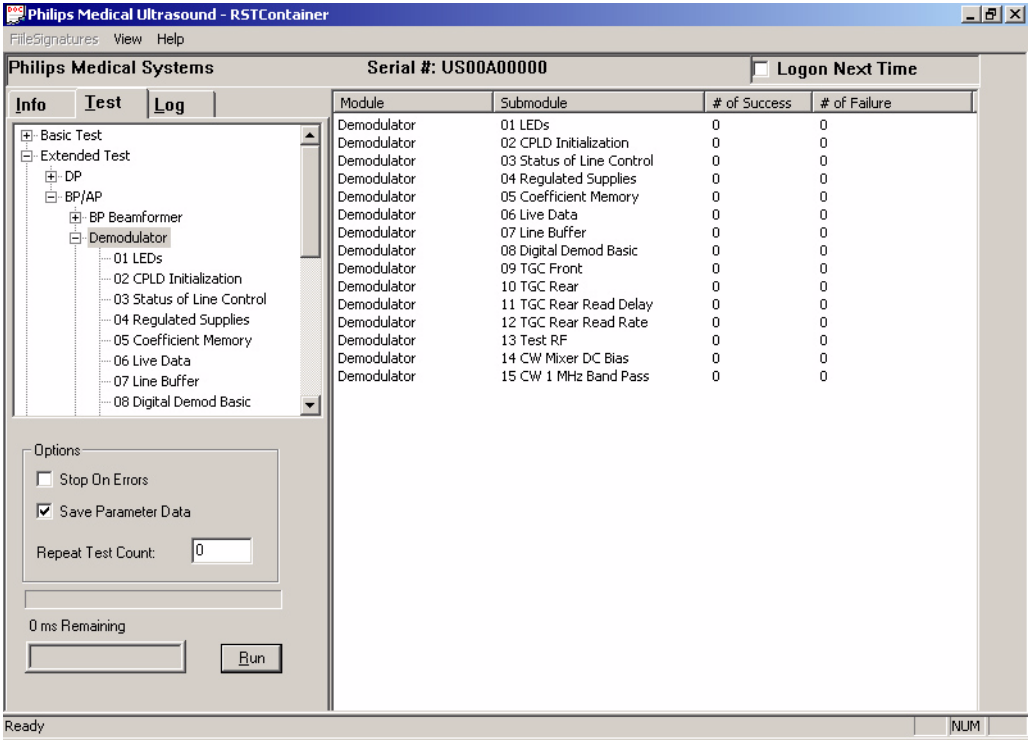


5. If you want to run specific tests, click the names of those tests. (See "Test Modules" on page 152.) To select all the extended tests, leave **Extended Test** selected.
6. To run the test a specific number of times, enter the number in the **Repeat Test Count:** field. To run the test continuously, enter zero in the field.
7. Click **Run**. Testing begins.
8. When the testing is done, click **OK** in the message box.

Test Modules

Each subsystem test consists of test modules, and each test module has submodules. You can select individual modules or submodules to run separate from the other tests in its group by using the tree control in the left side of the RST window. As an example, Figure 6-11 shows the BP/AP subsystem test's Demodulator test module and the module's submodules.

Figure 6-11 Demodulator Tests (Example)


Philips Medical Ultrasound - RSTContainer
FileSignatures View Help
Philips Medical Systems
Serial #: US00A00000
Logon Next Time
Info Test Log
Basic Test
Extended Test
DP
BP/AP
BP Beamformer
Demodulator
01 LEDs
02 CPLD Initialization
03 Status of Line Control
04 Regulated Supplies
05 Coefficient Memory
06 Live Data
07 Line Buffer
08 Digital Demod Basic
Options
Stop On Errors
Save Parameter Data
Repeat Test Count: 0
0 ms Remaining
Run
Module | Submodule | # of Success | # of Failure
Demodulator | 01 LEDs | 0 | 0
Demodulator | 02 CPLD Initialization | 0 | 0
Demodulator | 03 Status of Line Control | 0 | 0
Demodulator | 04 Regulated Supplies | 0 | 0
Demodulator | 05 Coefficient Memory | 0 | 0
Demodulator | 06 Live Data | 0 | 0
Demodulator | 07 Line Buffer | 0 | 0
Demodulator | 08 Digital Demod Basic | 0 | 0
Demodulator | 09 TGC Front | 0 | 0
Demodulator | 10 TGC Rear | 0 | 0
Demodulator | 11 TGC Rear Read Delay | 0 | 0
Demodulator | 12 TGC Rear Read Rate | 0 | 0
Demodulator | 13 Test RF | 0 | 0
Demodulator | 14 CW Mixer DC Bias | 0 | 0
Demodulator | 15 CW 1 MHz Band Pass | 0 | 0
Ready
NUM

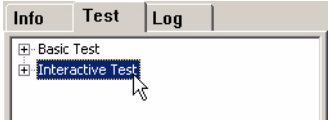
The two-digit codes that precede the submodule names are used in the Application Test Log display, in its Category column, and in the Status window at the lower left of the window. See "RST Test Log" on page 156.

➤ Running an Interactive Test

The interactive tests check the operation of the system's controls. They require you to make selections and operate controls as they execute.

To run an interactive test:

1. Start the RST application. See "Starting the RST Application" on page 149.
2. Log on using a valid service name and password.
3. Click the **Test** tab in the main RST window.
4. Click **Interactive Test** in the tree view, to show the available interactive tests.



5. Select the test you want to run.

NOTE Only one interactive test can run at a time.

6. Click **Run**. Testing begins.
7. Follow the instructions that the RST application displays.
8. To end a test, do the following:
   - To end a display test, press the **THI (Hx)** key.
   - To end a keyboard test, right-click the test name, and click **Stop** on the shortcut menu.

➤ Viewing Error Logs

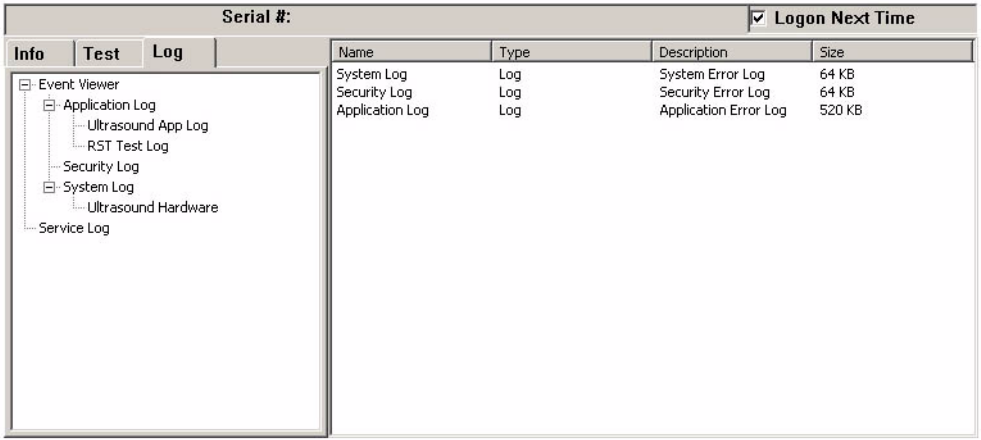
The RST application records errors in logs during operation of the system and when you run a test. The Event Viewer includes application logs, a security log, and a system log.

To view the logs:

- Click **Event Viewer** on the **Log** tab of the RST window and select the log you want to see. Figure 6-12 shows the RST log display.

The logs list errors in chronological order, with the most recent errors at the top of the list. You can view more detail of an error by double-clicking the entry in the list view.

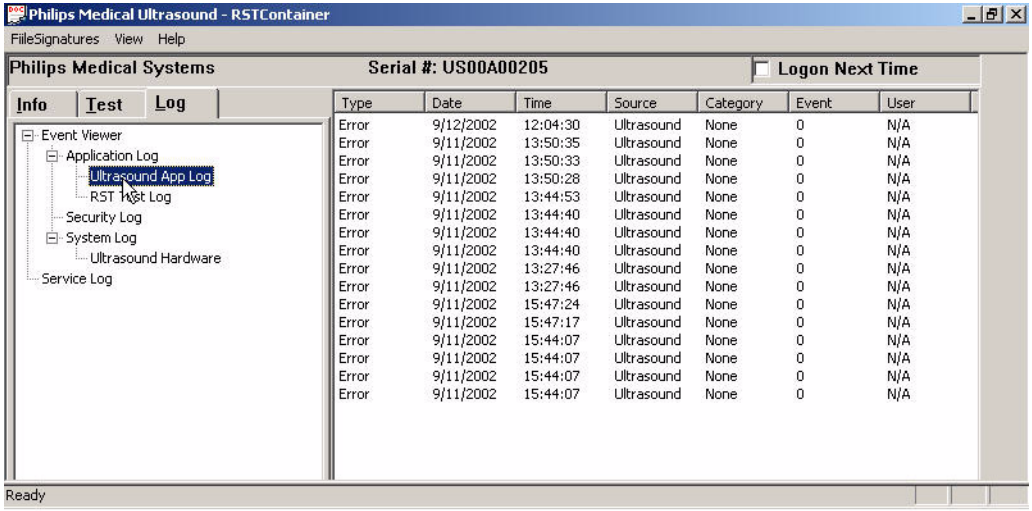
Figure 6-12 RST Log Display



Ultrasound Application Log

This log includes run-time errors encountered by both the ultrasound application and the RST application. The log lists the date and time the error occurred, the name of the error, the applications and subsystems affected, and other information. Figure 6-13 shows the ultrasound application log display.

Figure 6-13 Ultrasound Application Log Display


Philips Medical Ultrasound - RSTContainer
FileSignatures View Help
Philips Medical Systems
Serial #: US00A00205
Logon Next Time
Info Test Log
Event Viewer
Application Log
Ultrasound App Log
RST Test Log
Security Log
System Log
Ultrasound Hardware
Service Log
Type Date Time Source Category Event User
Error 9/12/2002 12:04:30 Ultrasound None 0 N/A
Error 9/11/2002 13:50:35 Ultrasound None 0 N/A
Error 9/11/2002 13:50:33 Ultrasound None 0 N/A
Error 9/11/2002 13:50:28 Ultrasound None 0 N/A
Error 9/11/2002 13:44:53 Ultrasound None 0 N/A
Error 9/11/2002 13:44:40 Ultrasound None 0 N/A
Error 9/11/2002 13:44:40 Ultrasound None 0 N/A
Error 9/11/2002 13:44:40 Ultrasound None 0 N/A
Error 9/11/2002 13:27:46 Ultrasound None 0 N/A
Error 9/11/2002 13:27:46 Ultrasound None 0 N/A
Error 9/11/2002 15:47:24 Ultrasound None 0 N/A
Error 9/11/2002 15:47:17 Ultrasound None 0 N/A
Error 9/11/2002 15:44:07 Ultrasound None 0 N/A
Error 9/11/2002 15:44:07 Ultrasound None 0 N/A
Error 9/11/2002 15:44:07 Ultrasound None 0 N/A
Error 9/11/2002 15:44:07 Ultrasound None 0 N/A
Ready

➤ Clearing the Ultrasound Application Log

To clear the Ultrasound Application Log:

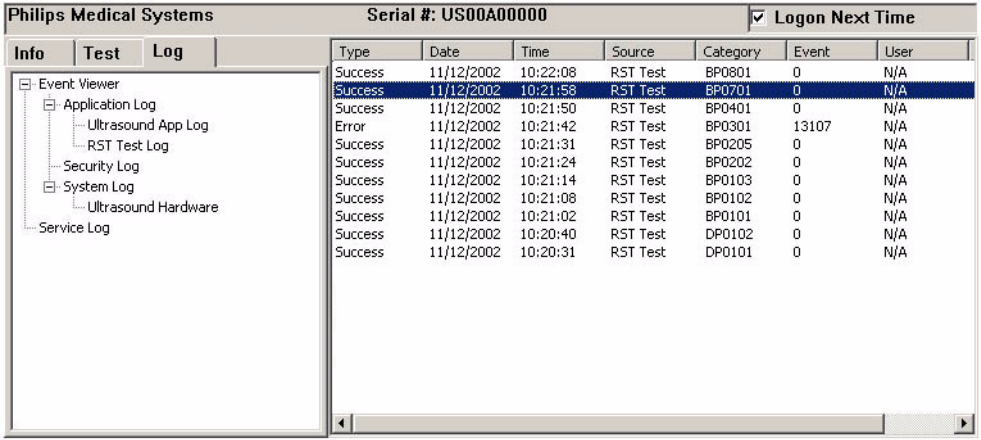
1. Right-click **Ultrasound App Log**.
2. Click **Clear Log** on the shortcut menu.
3. Click **Yes** in the confirmation dialog box.

RST Test Log

This log includes parameters of past RST tests and errors encountered while running the tests.

Figure 6-14 shows the Event Viewer Application RST Test Log.

Figure 6-14 Application RST Test Log Display


Philips Medical Systems
Serial #: US00A00000
Logon Next Time
Info
Test
Log
Event Viewer
Application Log
Ultrasound App Log
RST Test Log
Security Log
System Log
Ultrasound Hardware
Service Log
Type Date Time Source Category Event User
Success 11/12/2002 10:22:08 RST Test BP0801 0 N/A
Success 11/12/2002 10:21:58 RST Test BP0701 0 N/A
Success 11/12/2002 10:21:50 RST Test BP0401 0 N/A
Error 11/12/2002 10:21:42 RST Test BP0301 13107 N/A
Success 11/12/2002 10:21:31 RST Test BP0205 0 N/A
Success 11/12/2002 10:21:24 RST Test BP0202 0 N/A
Success 11/12/2002 10:21:14 RST Test BP0103 0 N/A
Success 11/12/2002 10:21:08 RST Test BP0102 0 N/A
Success 11/12/2002 10:21:02 RST Test BP0101 0 N/A
Success 11/12/2002 10:20:40 RST Test DP0102 0 N/A
Success 11/12/2002 10:20:31 RST Test DP0101 0 N/A

RST Log Codes

The Application Test Log's Category column contains coded information. The code is in the following format:

SSnnNN

Where:

- *SS* is the subsystem tested.
  - BP is the beam processor subsystem.
  - DP is the display processor subsystem.
- *nn* is the module number of the tested module.
- *NN* is the submodule number.

Example: DP0102

The example indicates that the A/D converter (submodule 02 of module 01) of the display processor was tested.

To find the meaning of the numeric codes, use the tree control in the RST window's left side as described in "Test Modules" on page 152.

➤ Clearing the RST Test Log

To clear the RST Test log:

1. Right-click **RST Test Log** in the tree view.
2. Click **Clear Log** on the shortcut menu.
3. Click **Yes** in the confirmation dialog box.

Test Result Details

You can view test results in the Event Properties window. The details of the test results may provide clues for diagnosing system problems.

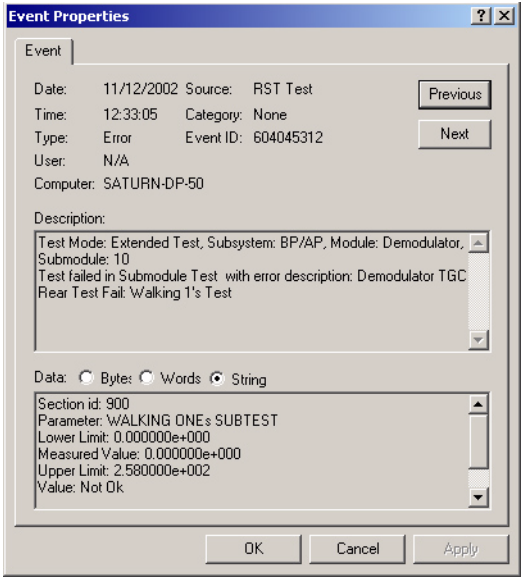
➤ Viewing Test Details

To view the test details:

1. In the right side of the Event Viewer window, double-click the event you want detailed information on.

   The Event Properties window opens (Figure 6-15).

Figure 6-15 Event Properties Window (Example)

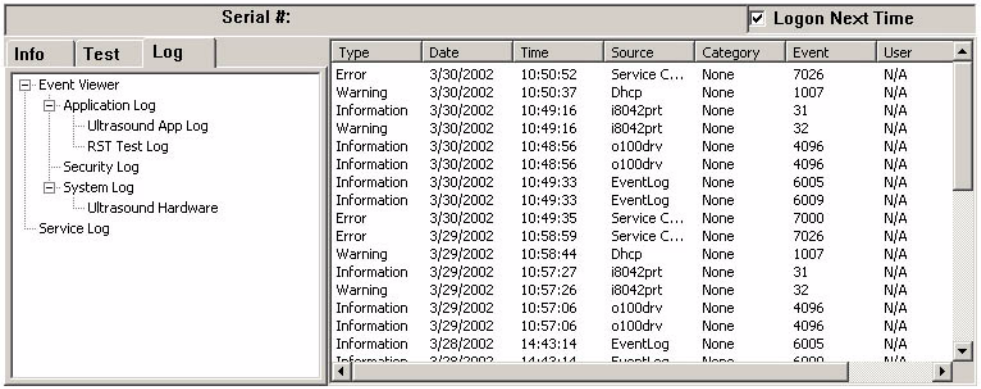


2. Click the appropriate **Data:** option button to change the data display type. Typically, the string option provides the most useful information.

System Log

The Event Viewer system log includes hardware errors filtered from the application run-time error log and the RST test log. Figure 6-16 shows the Event Viewer system log.

Figure 6-16 System Log Display


Serial #:
Logon Next Time
Info
Test
Log
Event Viewer
Application Log
Ultrasound App Log
RST Test Log
Security Log
System Log
Ultrasound Hardware
Service Log
Type Date Time Source Category Event User
Error 3/30/2002 10:50:52 Service C... None 7026 N/A
Warning 3/30/2002 10:50:37 Dhcp None 1007 N/A
Information 3/30/2002 10:49:16 i8042prt None 31 N/A
Warning 3/30/2002 10:49:16 i8042prt None 32 N/A
Information 3/30/2002 10:48:56 o100drv None 4096 N/A
Information 3/30/2002 10:48:56 o100drv None 4096 N/A
Information 3/30/2002 10:49:33 EventLog None 6005 N/A
Information 3/30/2002 10:49:33 EventLog None 6009 N/A
Error 3/30/2002 10:49:35 Service C... None 7000 N/A
Error 3/29/2002 10:58:59 Service C... None 7026 N/A
Warning 3/29/2002 10:58:44 Dhcp None 1007 N/A
Information 3/29/2002 10:57:27 i8042prt None 31 N/A
Warning 3/29/2002 10:57:26 i8042prt None 32 N/A
Information 3/29/2002 10:57:06 o100drv None 4096 N/A
Information 3/29/2002 10:57:06 o100drv None 4096 N/A
Information 3/28/2002 14:43:14 EventLog None 6005 N/A

➤ Clearing the System Log

To clear the system log:

1. Right-click **System Log** in the tree view.
2. Click **Clear Log** on the shortcut menu.
3. Click **Yes** in the confirmation dialog box.

Using the Service Log

The Service Log is a list of comments entered by service personnel.

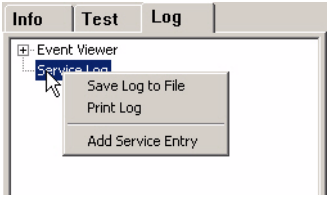
➤ Making an Entry in the Service Log

You can enter information in the Service Log that is displayed on the **Log** tab. You must log on to the RST application by using a valid service name and password to make an entry in the service log.

To make a new entry in the service log:

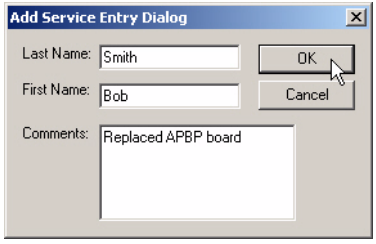
1. Start the RST application. See "Starting the RST Application" on page 149.
2. Log on using a valid service name and password.
3. Right-click **Service Log** (use the **Select** key on the system control panel).

   A shortcut menu opens.



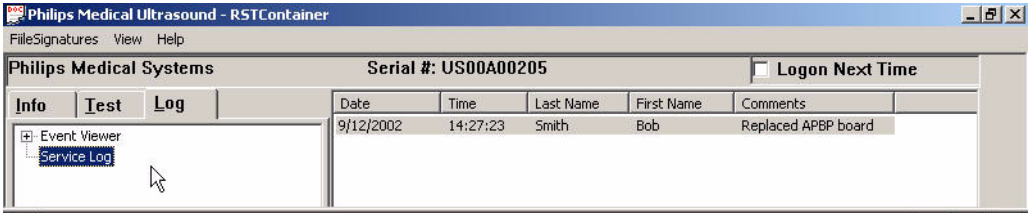
4. Click **Add Service Entry**.

   The Add Service Entry window opens.



5. Type your name in the top two fields, and the service information in the **Comments:** field.
6. Click **OK**.

   Your entry appears in the service log.



7. Right-click **Service Log** and click **Save Log to File** to save the entry.

➤ Modifying an Entry in the Service Log

You can change the information in an existing service log entry. You must log on to the RST application by using a valid service name and password to modify an entry in the service log.

To modify a service log entry:

1. Start the RST application. See "Starting the RST Application" on page 149.
2. Log on using a valid service name and password.
3. Click **Service Log**.
4. Double-click the log entry you want to modify.

   The Change Service Entry window is displayed.
5. Click in the entry field and modify the text.
6. Click **OK**.
7. Right-click **Service Log** and click **Save Log to File** to save the modification.

7 Adjustments

Monitor Adjustment

The four buttons on the front of the monitor adjust brightness and contrast. When the two right buttons are pressed simultaneously as the monitor powers up, the OSD Main menu is available. Submenus of the OSD Main Menu control the size and geometry of the display and set the monitor's signal input voltage (see "Monitor Signal Voltage" on page 73).

Pressing the two right buttons together degausses the CRT.

OSD Main Menu

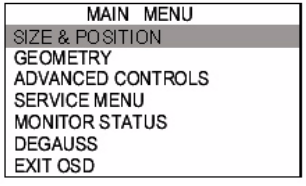
➤ Opening the OSD Main Menu

To open the OSD Main Menu:

1. Disconnect the power cord from the rear of the monitor.
2. Press the two right-hand monitor buttons, and hold them in while reconnecting the power cord.
3. Press the two center monitor buttons.

NOTE Do not press the two center buttons for longer than 10 seconds or the OSD menu locks and you will not be able to make any adjustments. To unlock the menu, press the two center buttons for more than 10 seconds or until the unlocked message appears and then release the buttons. Press the buttons again until the Main Menu appears.

The OSD Main Menu is displayed.



Navigating the OSD Menus

The four buttons on the front of the monitor control all the OSD functions, as follows:

- Brightness down (leftmost button) applies the selected menu item.
- Brightness up + Brightness down exits a menu without saving any changes.
- *Contrast down* moves down one OSD Menu item or decreases the value of the selected parameter.
- *Contrast up* (rightmost button) moves up to the previous OSD menu item or increases the value of the selected parameter.

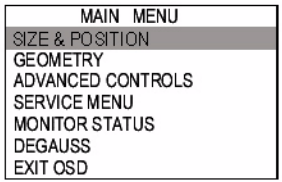
Adjusting VGA Vertical Size

For viewing BIOS settings mode, you must adjust the VGA vertical size. This adjustment does not affect the normal display mode.

➤ Adjusting the VGA Vertical Size

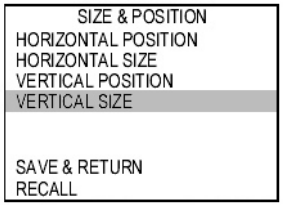
1. Reboot the system.
2. As the system boots up, press the **Patient** key repeatedly, until the BIOS screen opens.
3. Disconnect the power cord from the rear of the monitor.
4. Press the two monitor buttons on the right, and hold them in while reconnecting the power cord.
5. Press the two center monitor buttons.

   The OSD Main menu is displayed.



6. Use the two monitor buttons on the right to scroll up or down in the OSD Main menu and select **SIZE & POSITION**.
7. Press the leftmost monitor button.

   The Size & Position menu is displayed.



8. Use the two monitor buttons on the right to select **VERTICAL SIZE**.
9. Press the far left monitor button.

   The vertical size adjustment bar is displayed.

10. Use the two monitor buttons on the right to adjust the vertical size so the bottom of the display is visible.
11. Press the leftmost monitor button.

    The vertical size adjustment bar closes.
12. Use the two monitor buttons on the right to select **SAVE & RETURN** in the Size & Position menu.
13. Press the leftmost monitor button.

    The Size & Position menu closes.
14. In the OSD Main menu, use the two monitor buttons on the right to select **EXIT OSD**.
15. Press the leftmost monitor button.

Changing the Boot Sequence

You can change the device from which the system boots either:

- Permanently, so all subsequent system startups use the boot sequence
- Temporarily, to change the sequence for the current startup.

Changing the Boot Sequence Permanently

To change the boot sequence permanently:

1. **Reboot** the system.
2. As the system boots up, press the **Preset** key repeatedly until the BIOS Setup Utility screen opens.
3. Use the arrow keys to select **Boot**.
4. Use the arrow keys to select **Boot Device Priority** and press **Return**.

   The Device menu opens.
5. Use the arrow keys to select the drive to boot from:
   - Select **Removable Dev.** for the floppy disk drive.
   - Select **ATAPI CD-ROM** for the CD-ROM drive.
6. Press **Return**.
7. Press the (2) **key** to return to the Device menu.
8. Ensure that **[Yes]** is highlighted and press **Return** to confirm the changes.
9. Press the power switch to shut down the system. (Don't let it reboot from the dialog box.)
10. After 15 seconds, press the power switch to start the system.

Changing the Boot Sequence Temporarily

To change the boot sequence temporarily:

1. Adjust the VGA display height to show the whole screen. See "Adjusting VGA Vertical Size" on page 164.
2. **Reboot** the system.
3. As the system boots up, press the **Mic** key repeatedly, until the **Please Select Boot Device** screen opens.
4. Use the arrow keys to select the drive to boot from:
   - Select **Removable Dev.** for the floppy disk drive.
   - Select **ATAPI CD-ROM** for the CD-ROM drive.
5. Press **Return**.

8 Preventive Maintenance

This section contains procedures for cleaning the M2540A and its components.

During preventive maintenance (PM), look for conditions that may cause problems, and loose knobs or worn TGC controls.

CAUTION Use adequate ESD safeguards when performing service and maintenance procedures. See "ESD Safeguards" on page 180.

NOTE *Do not* use commercial cleaners to clean any surfaces of the ultrasound system. These cleaners may cause the colors to fade. Use only mild soap.

➤ Cleaning the Air Filter

The air filter resides inside the service panel at the right front of the lower enclosure, in front of the fan. If the filter becomes very dirty, it can impede airflow, which may cause overheating of the power supply or the e-box.

To remove and clean the air filter:

1. Remove the service panel at the right front of the lower enclosure. See "Front Service Panel" on page 182.
2. Slide the filter up and out of the panel's back.
3. Wash the filter with a spray of water from the side that faced the fan.

CAUTION

Do not use any solvent other than water to wash the air filter. Other solvents may corrade its material.

4. Dry the filter thoroughly before replacing it in the system. Compressed air can speed drying.
5. Replace the filter.
   a. Slide the filter into the panel's back.
   b. Replace the service cover.

➤ Cleaning the Trackball

To clean the trackball:

1. Unscrew and remove the bezel that surrounds the trackball in the surface of the system control panel. A paper clip inserted in one of the small holes in the bezel can help to start unscrewing the bezel.
2. Press up from under the trackball and remove it.
3. Clean the trackball with an alcohol-dampened pad.
4. Clean the two encoder shafts and the bearing surface with an alcohol-dampened pad.
5. Replace the trackball and bezel.

➤ Cleaning the E-box

Inspect the interior of the e-box for dust (see "Replacing E-box Circuit Boards" on page 195), and vacuum if necessary.

CAUTION Use proper ESD precautions for the vacuum itself and when removing circuit boards for vacuuming. See "ESD Safeguards" on page 180.

CAUTION Because the M2540A's circuit boards have components on both sides, use caution when removing them from the system. After removal, make sure the boards lie flat on an ESD protected surface. Use adequate ESD safeguards when performing any service or maintenance procedure. See "ESD Safeguards" on page 180.

➤ Cleaning the PC

Inspect the interior of the e-box for dust and vacuum if necessary using an ESD vacuum cleaner.

Perform all RST and system checks to verify performance.

➤ Degaussing the Monitor

To degauss the monitor, press the two right-hand monitor buttons at the same time.

9 Troubleshooting

This section contains tips and procedures for finding the causes of malfunctions of the M2540A.

Always check that power cords are plugged in, and inspect them for wear.

PC Will Not Boot

If the M2540A does not start when you press the PC's power button, proceed as follows:

1. Confirm that the system power cord is plugged in.
2. Remove the service panel from the front of the lower enclosure by pressing down its two latches. A green LED on the left side of the power supply, above the fan, indicates that the power supply is energized by line voltage from the mains. The LED takes a few seconds to light when the system is first plugged in.

NOTE When the PC is not on, or when the token ring cable is disconnected, you can activate the power supply by jumping the PWR DOWN pin on the BPAP board to chassis ground.

3. Unplug the PC power cord from the top outlet on the power supply. If necessary, change the PC power selector switch (located directly below the power cord connector) to match the local voltage.

CAUTION

The input voltage of the PC in the EnVisor system is always set to 115 V. If you connect the PC directly to the wall outlet, be sure to change the power selector switch to match the local voltage. Failure to do so will result in damage to the PC.

4. Connect the PC to the wall outlet.

5. Press the PC power button.
   - If the PC starts, the power supply is bad. Replace it. See "Power Supply" on page 199.
   - If the PC does not start, try replacing its power cord. If the PC still does not boot, it is faulty. See "PC Service" on page 192.
6. Reset the PC power selector switch to 120 V, if the switch was moved in step 3.

PC Boots, but Monitor is Blank

If the M2540A's internal PC starts, but the monitor stays blank, proceed as follows:

1. Connect a jumper between chassis ground and the PWR DOWN pin on the BPAP board.
   - If the monitor now turns on, check the token ring cable.
   - If the monitor remains blank, continue with the following steps.
2. Shut down the PC.
3. Unplug the PC power cable from the back of the PC.
4. Unplug the monitor's power cable from the monitor.
5. Plug the PC power cable into the back of the monitor.
   - If the monitor turns on, the power supply is bad. Replace it. See "Power Supply" on page 199.
   - If the monitor does not turn on, it is faulty. Replace it. See "Replacing the Monitor" on page 203.

PC Boots, but Ultrasound Application Fails to Start

If the M2540A's internal PC starts, but the ultrasound application fails to start properly (EnVisor splash screen remains on the monitor or the internal error message dialog box appears each time it starts up, proceed as follows:

1. Turn off the system and remove the APIO board from the PC.

2. Connect a jumper between the chassis ground and the PWR DOWN pin on the BPAP board.
3. Press the power button to start the PC.

If the ultrasound application now starts properly (there will be only noise in the image area), the PC is okay and the problem is in one of the following:

- E-box (probably BPAP board)
- Token ring cable
- APIO board

If after checking the items in the preceding list, the ultrasound application still does not start, the problem is in the PC. Try to diagnose the problem using the IBM drive fitness test. See "IBM Drive Fitness Test" on page 142.

PC Boots, but Peripherals Don't Work

If the M2540A's internal PC starts, and the monitor functions normally, but one or more peripheral devices do not work, proceed as follows:

1. Run the RST and other system checks, and check the device's power cord connections.
2. Shut down the PC.
3. Unplug the PC power cable from the back of the PC.
4. Unplug the malfunctioning device's power cable from the device.
5. Plug the PC power cable into the back of the device.
   - If the device turns on, the power supply is bad. Replace it. See "Power Supply" on page 199.
   - If the device does not turn on, try replacing its power cord. If the device still does not power up, it is faulty. Replace the device.

System Starts, but Database Reset Message Appears

This problem occurs when and invalid language is set for the user interface language. To reset the user interface language to a valid language, see "Setting the User Interface Language" on page 79.

Non-English User Interface

To change the system user interface language to English:

1. On the Setup window, click the **Locale** button.
2. On the Regional and Languages Options window, click the **Languages** tab.
3. Choose **English**.
4. Click **OK**.
5. Restart the system.

Input Language Is Non-English

If you are required to type in English on a non-English system, you can use English if the system was set up with the English keyboard. Press left Alt+Shift to cycle through the languages until you find English.

OSD Main Menu is Locked

If the two center monitor buttons are pressed for longer than 10 seconds, the message, "OSD MAIN MENU LOCKED" appears.

To unlock the menu:

1. Press the two center monitor buttons for at least 10 seconds or until the messages changes to: "OSD MAIN MENU UNLOCKED."
2. Release the buttons.
3. Press the two center buttons again until the Main Menu appears.

Over Temperature Message Is Displayed

If an over temperature message is displayed, proceed as follows:

1. Verify that the room temperature is not outside of the operating temperature range (0–40°C).
2. Inspect the air filter to make sure is clean.
3. Inspect the E-box to make sure it is clean and free of dust.
4. Verify that the fan is operating when the system is turned on.
5. Verify that the two heat sinks on the BPAP board are properly attached.
6. If the over temperature message is still displayed, replace the BPAP board.

Keyboard Swivel Does Not Lock

Early EnVisor systems may develop a problem where the lock for the keyboard swivel does not lock in certain positions (typically straight ahead). The problem is caused by a deformed detent ring. To replace the detent ring, see "Detent Ring" on page 207.

Printer Problems

HP940 Startup

The first time the HP940 printer is turned on, it may cause the system to hunt for more peripherals to install. Rebooting the system stops this activity.

HP1200 Printing

If the HP1200 does not print ultrasound displays as part of reports, perform the procedure in "HP1200" on page 109.

Printer Installation Problems

If a connected printer does not show up on the Setup/Peripherals screen, perform the following procedure:

1. Use the scroll bar in the options field to make sure you see all the printers in the list.

2. Make sure that the printer is connected to a live power source, that its USB cable is properly connected at both ends, that the printer is turned on, and that the printer shows no error indicators.
3. Reboot the M2540A, and see if the printer appears on the **Setup/Peripherals** screen.
4. Disconnect the **USB cable** from the printer.
5. Press the **Setup** key.
6. On the Setup window, click the **Peripherals** tab.
7. Click **Install Software Drivers**.
8. Click **Printer**.
9. Click **OK**.
10. Click **Close**.
11. Shut down the M2540A.
12. Connect the **USB cable** to the printer.
13. Start the M2540A.

If the procedure does not solve the problem, contact your Philips service representative.

EMI

Electromagnetic interference (EMI) can degrade the performance of the M2540A. A transducer placed close to an ECG cable can increase interference. Moving the ECG cable or other medical equipment away from the transducer can reduce interference.

Answering the following questions can help locate the source of interference:

- Is the interference intermittent or constant?
- Does the interference appear with only one transducer or with several transducers?
- Do two different transducers operating at the same frequency have the same problem?

- Is the interference present if the system is moved to a different location in the facility?
- Can the EMC coupling path be attenuated?

Answers to these questions help determine whether the problem is with the system or with the scanning environment. Contact your local Philips service representative with a full description and your observations.

Using the Maintenance Tools

The system provides maintenance tools that you access through the Field Service Options window. These tools are useful while troubleshooting.

To access the Field Service Options window:

1. Press the **Setup** key.

   The Setup window opens.
2. On the Setup window, click the **Options** tab.
3. Click **Service**.

   The Field Service Options window opens.

Figure 9-1 Field Service Options Window

4. Click the option you want to use.

5. In the dialog box that appears, type the password and click **OK**.

The following table describes the Field Service Window options. With the exception of **Command Line**, you must reboot the system after using the options.

Option	Description
Notepad	Opens the Windows Notepad application. Allows you to create, edit, or view text files.
Control Panel	Opens the Windows Control Panel that allows you to access Windows settings and options.
RegEdit	Accesses the Windows registry for editing if you are instructed to do so.
Command Line	Accesses the DOS window, in which you can access PC files and functions by using DOS commands.
Event Viewer	Opens the Windows Event Viewer window where you can view and manage logs of system, program, and security events on your computer. Event Viewer gathers information about hardware and software problems, and monitors Windows security events. You can export event viewer data to external media.
Task Manager	Opens the Windows Task Manager to allow you to view system performance and applications and processes running on the PC. Allows you to end programs or processes, to start programs, and to view a dynamic display of PC performance.
Explorer	Opens the Windows Explorer, in which you can view the system directories and files. You can copy, move, rename, and search for files and folders. To access Explorer, click the **Explorer** button, wait for the hourglass to disappear, and then click the **Explorer** button again.

Option	Description
Disk Defrag	Opens the Windows Disk Defragmenter, which allows you to rearrange files and unused space on the hard disk, to make the software run faster, and to increase the speed of access and retrieval.
Save Debug Info	Allows you to export debug files to a floppy disk, an MOD, or a CD-R. Debug files are created when internal errors occur. Information is collected in a diagnostics directory, which is labeled with the date and time of the error. The collected information includes the event log, the Dr. Watson log, and a memory dump of what was in memory at the time the error occurred. If an error occurs while the system is shutting down, information about the 10 previous shutdowns is saved. To export the debug information, click the appropriate directory, select the drive to which you want to export, and click Save. If you save the debug info to a floppy disk, the memory dump is not written to the floppy disk because of space limitations.
Change Serial #	Allows you to change the serial number of the system. You must have an access code to use this feature.

10 Service Procedures

Overview

This section includes all the service procedures for the M2540A. To locate parts and assemblies referred to in the procedures, see the exploded diagrams and parts lists in "Parts" on page 229. This manual does not include service procedures for optional peripherals.

Repair Philosophy

Most components in the M2540A are replaced as modules. The power supply, the monitor, and the system control panel are not serviceable, and are replaced as units. The circuit boards and function cards inside the M2540A's internal PC and e-box are replaceable in the field. Some parts are available at reduced cost, as exchange items.

ESD Safeguards

Follow the electrical static discharge (ESD) guidelines in this section to prevent deterioration or destruction of sensitive electronic components. General guidelines include:

- Avoid working in carpeted areas.
- If you use a vacuum cleaner to clean the interior of any part of the system sensitive to static electricity, take the necessary ESD precautions to avoid static buildup and discharge.
- Use a properly grounded wrist strap.
- Use a grounding mat for assembly work on sensitive areas.

General Precautions

Liquids, including ultrasound gel, can adversely affect the system control panel and other surfaces. A protective membrane under the keyboard provides some protection against spills, but liquids may seep into electrical components under the panel and cause problems.

To prevent damage to the system, consider the following good practices:

- Turn the system off when not in use.
- Do not remove or install boards or cables with the system power on.

- Lock the system's wheels when removing or installing circuit boards.
- When the system is on but not in use, leave the **Power** control at the lowest setting.

Service Access

This section describes how to gain access to the serviceable components of the M2540A system.

Servicing Components Above the Lower Enclosure

You can service components mounted above the lower enclosure without opening any panels in the lower enclosure. These components include the following:

- External peripheral components
- Monitor (page 202)
- Twivel (page 203)
- System control panel (page 204)
- Monitor support (page 205)

Servicing Components in the Lower Enclosure

To service components mounted in the lower enclosure, you must open one or more panels on the lower enclosure. For locations of the panels and components, see Figure 13-3 on page 237.

The components in the lower enclosure include the following:

- System PC (page 192)
- E-box (page 195)
- Power supply (page 199)
- Transducer connector modules (page 200)
- Fan (page 202)
- Cables (page 206)
- Lift column (page 213)
- Cart wheels (page 211)
- Lower enclosure top panel (page 212)

Rear Service Doors

Two doors in the rear of the lower enclosure give access to the rear of the PC, the e-box, and the power supply. The doors are hinged near the center of the system, and are held closed by quarter-turn latches near the sides of the system. To open the doors, turn the latches counterclockwise.

NOTE References to the left and right sides of the system are as viewed from the front of the system.

Front Service Panel

A panel at the right side of the system's front gives access to the transducer connector module mounting, the air filter, the fan, the front of the e-box, and the front of the power supply.

To open this panel:

- Press down the two latches at the top of the panel, pull the top edge out, and lift the panel clear of the system.

Side Panels

The two lower enclosure side panels are attached with screws on their lower edge.

To remove either panel:

- Remove the three screws along the panel's lower edge, pull the bottom of the panel out, and lower the panel clear of the system.

Record Keeping

You can make notes in the RST application's service log, to help with later service procedures. To read service log entries, see "Using the Service Log" on page 161. To make an entry in the RST service log, see "Making an Entry in the Service Log" on page 161.

Software

This section contains procedures for servicing M2540A software. The following procedures describe reloading and upgrading the ultrasound software, and backing up and restoring system options and customer presets.

Installing the System Software

Complete the following procedure to reload or upgrade the system software. The procedure takes about 1 hour to complete and requires the following CDs:

- Operating System
- Ultrasound Application
- COTS Drivers

CAUTION

Installing the system software erases all data on the system's hard drive. Before you reload the system software, save any needed patient data to removable media or to a DICOM PACS.

Before You Begin

Before you begin installing the software, perform the following tasks:

- Ensure the customer has saved any important studies.
- Make a backup floppy of the system software options and custom presets. See "Creating a Backup Floppy" on page 184.
- If the system is configured for network connection, write down the network settings. See "Recording the Network Settings" on page 187.
- Back up the Service Log. See "Backing Up the Service Log" on page 187.

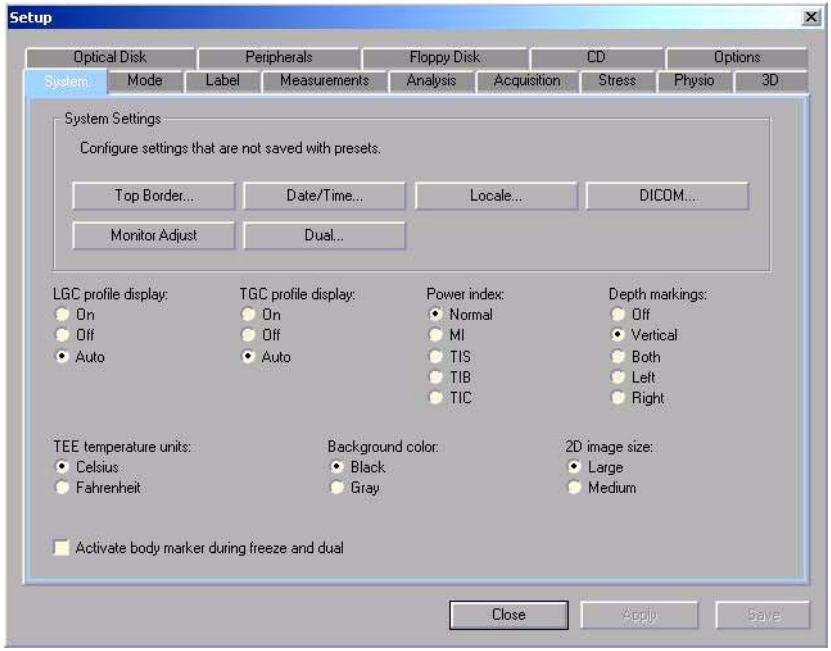
Creating a Backup Floppy

To create a back up floppy:

1. Start the M2540A.
2. Insert a blank floppy disk in the PC's floppy disk drive.
3. With the ultrasound application running, press the **Setup** key.

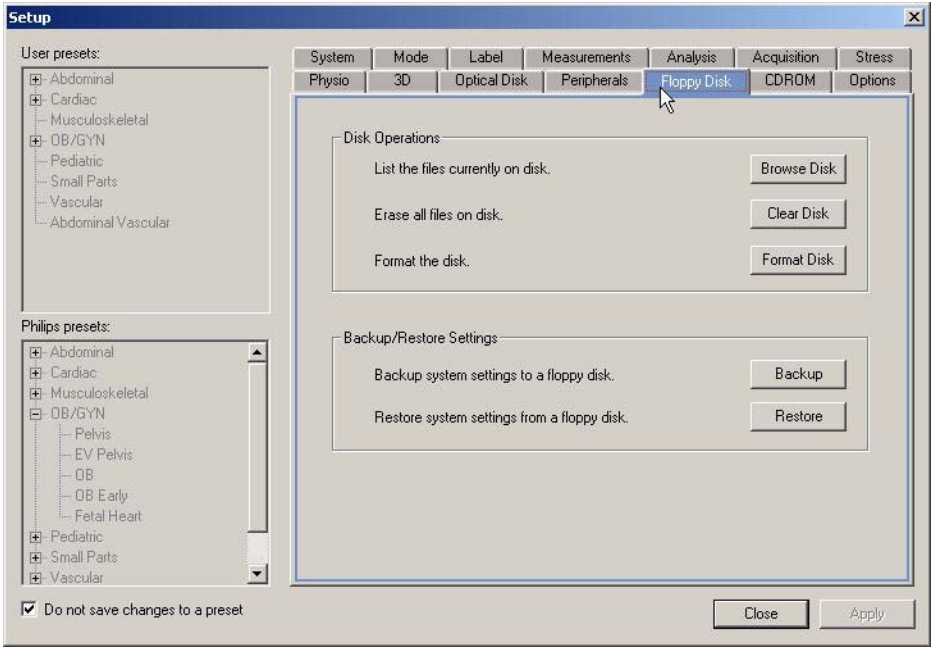
   The Setup window opens.

Figure 10-1 Setup Window



4. Click the **Floppy Disk** tab.

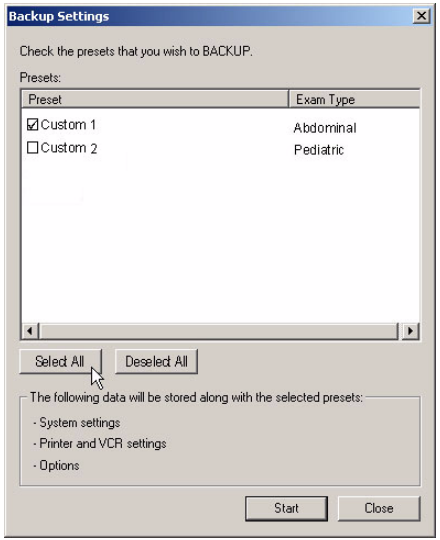
Figure 10-2 Settings Window (Floppy Disk)



5. Click **Backup**.

   The Backup Settings window opens.

Figure 10-3 Backup Settings Window



6. Click **Select All**.
7. Click **Start**.

   The backup procedure runs. When the procedure is done, the Backup Settings window closes.

NOTE While it backs up the presets, the backup program also automatically backs up the system settings, the peripheral settings, and the installed options.

8. Click **Close**.
9. Remove the floppy disk.

Recording the Network Settings

To record the network settings:

1. With the ultrasound application running, press the **Setup** key.

   The Setup window opens.

2. Click the **This System** tab.
3. Click the **Dicom...** button.
4. Click the **This System** tab.
5. Click **Network Settings**.
6. Write down the displayed settings.

Backing Up the Service Log

If there are entries in the Service log, back them up to a floppy before reinstalling software:

1. Insert a formatted blank floppy disk in the PC's floppy disk drive.
2. Press the **Setup** key.
3. In the Setup window, click the **Options** tab.
4. Click **Service** and type the password in the **Access Code Required** window.
5. Click **Explorer**, wait for the hourglass to disappear, and click **Explorer** again.
6. In Window Explorer, access C:\Program Files\Philips\Mercury\Release\RSTService.txt and copy the RSTService.txt file to the floppy disk.

Installing the Software

To reload or upgrade the system software:

1. Turn off all peripherals and disconnect the USB cables from all printers.
2. Remove all removable media from the disk drives before beginning software installation.
3. Put the **Put this CD in first** Operating System CD into the CD drive.
4. Restart the system.
5. When the message "Press any key to boot from CD" (which is displayed briefly during startup) appears, press the **Return** key. You must do this within 5 seconds after the message appears.
6. When the message "Type of installation" appears, press **A** (automatic).

NOTE The message "Press any key to boot from CD" appears two more times during the installation. *Do not* press a key when this message appears. The message clears after a few moments.

7. When the system prompts you to insert another CD, remove the current CD and replace it with the indicated CD and press **Y**.

   When the COTS software installation finishes, the system automatically restarts. If the installation is successful, the monitor displays the ultrasound imaging screen.
8. When the ultrasound imaging screen appears, remove the final installation CD.

After Installation

After you install the software, perform the following tasks:

- Restore from the backup floppy. See "Restoring System Options and Custom Presets" on page 189.
- Reconnect the peripherals.
- Set the date, time, and time zone. See "Setting the Date and Time" on page 77.
- Restore the Network Settings. See "Restoring the Network Settings" on page 191.
- Restore the Service Log. See "Restoring the Service Log" on page 191.
- Set the language options. See "Setting the User Interface Language" on page 79 and "Setting the Input Language" on page 81.
- Check the operation of all peripherals.
- If a plain paper printer is connected, restart the system to ensure proper communication.
- Perform all checks as required by the Test and Inspection matrices.

Restoring System Options and Custom Presets

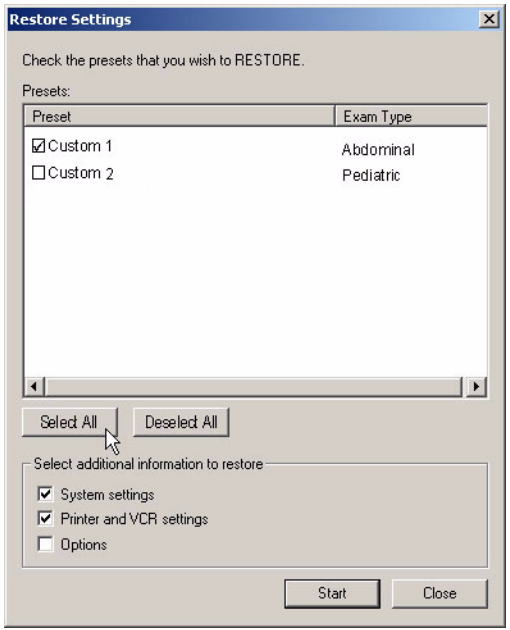
To restore a customer's presets:

1. Insert the backup floppy disk you created before installing the software.
2. With the ultrasound application running, press the **Setup** key on the system control panel. The Setup window opens.
3. Click the **Floppy Disk** tab.
4. Click **Restore**.

   The first time you click Restore, the presets do not appear in the window because no applications are yet installed on the system.

The Restore Settings window opens.

Figure 10-4 Restore Settings Window



5. Click **Select All**.
6. Click all the check boxes for **System Settings**, **Printer and VCR Settings**, and **Options**.

NOTE Options can be restored only to the system that created the backup floppy. The software matches the serial number of the system to that of the system that created the disk.

7. Click **Start**.
8. When the restoration is complete, click **Restore**.

   All presets on the backup floppy should appear in the Restore Settings window.
9. Click **Select All**.
10. Click **Start**.
11. When the restoration is complete, click **Close**.
12. Remove the floppy disk.

Restoring the Network Settings

To restore the network settings:

1. With the ultrasound application running, press the **Setup** key.

   The Setup window opens.
2. Click the **This System** tab.
3. Click the **Dicom...** button.
4. Click the **This System** tab.
5. Click **Network Settings**.
6. Enter the settings you recorded in "Recording the Network Settings" on page 187.

Restoring the Service Log

To restore the Service Log:

1. Insert the floppy disk that contains the backed-up Service Log into the PC's floppy disk drive.
2. Press the **Setup** key.
3. In the Setup window, click the **Options** tab.

4. Click **Service** and type the password in the **Access Code Required** window.
5. Click **Explorer**, wait for the hourglass to disappear, and click **Explorer** again.
6. In Window Explorer, access C:\Program Files\Philips\Mercury\Release and copy and paste the RSTService.txt file from the floppy disk.

PC Service

This section contains procedures for servicing M2540A hardware components of the internal PC.

PC Components

None of the PC's internal components are adjustable or repairable. Faulty PC components require replacement. You can replace some PC components without removing the PC from the system, by opening the side of the PC. (See "Opening the PC Side Cover" on page 193.) To replace other components, you must remove the PC from the system. (See "Removing the PC from the System" on page 194.)

The PC contains the following replaceable components (shown in Figure 13-1, on page 232):

- PC motherboard
- PC power supply
- Hard drive

NOTE The hard drive's jumper must be set as shown in Figure 12-1 on page 225.

- CD-RW drive
- Floppy disk drive
- APIO board
- Graphics adapter board
- Sound board (part of the VCR option)

- Video capture board (part of the VCR option)
- Video converter board (part of the VCR option)
- Optional Physio module
- Optional MOD drive
- Battery (not shown)

➤ Opening the PC Side Cover

You can gain access to components in the PC without removing the PC from the system, by opening the PC side cover.

To open the PC side cover, see Figure 13-3 on page 237 to locate parts and assemblies, and complete the following procedure:

CAUTION

Always observe proper ESD procedures when servicing the inside of the PC. Wear a grounded wrist strap, and work on a static-dissipating mat if possible.

1. Disconnect the system power cord from the main AC supply.
2. Remove the three screws from the lower edge of the lower enclosure's left side panel, pull the bottom of the panel out, and lower the panel clear of the system.
3. Remove the knurled screws from the back of the PC, and slide the cover to the rear.
4. Remove the PC side cover.
5. Disconnect any cables that are connected to the component you are removing.

6. If you are replacing the CD-RW drive, the Physio module, the MOD drive, or the floppy disk drive, do the following:
   a. Slide the PC 2 cm to the left, away from the center of the system.
   b. Gently pull the four plastic latches at the left side of the PC's bezel, while pulling the left side of the bezel forward until the latches clear the PC case.
   c. Slide the bezel to the right until it can be removed.
   d. Each of the replaceable parts listed in step 6 is retained by two plastic drive slides. To remove the part, press the two slides in toward the part, and slide the part out of the PC case.
7. Reverse the procedure to reassemble the PC.
8. Perform all RST and system checks to verify performance.

➤ Removing the PC from the System

To remove the PC, see Figure 13-3 on page 237 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove the three screws from the lower edge of the lower enclosure's left side panel, pull the bottom of the panel out, and lower the panel clear of the system.
3. Disconnect all the cables from the PC. Note their locations so you can reinstall them properly.
4. Loosen the screws in the angle bracket on the wall toward the center of the system. Remove the screws that secure the PC to the angle bracket.
5. Remove the PC through the side of the system.
6. Reverse the procedure to install the PC in the system.

7. Perform all RST and system checks to verify performance.

➤ Replacing the PC Battery

The PC battery is a lithium coin cell, CR2032, which you can purchase locally.

To replace the PC battery:

1. Open the PC side cover as described in "Opening the PC Side Cover" on page 193.
2. Remove the battery from the motherboard. The battery is located directly below the Graphics AGP card and behind the Video Converter PCI card (if installed).
3. Install the new battery.
4. Replace the PC side cover.
5. Turn on the system and configure the BIOS settings as described in "BIOS Settings" on page 227.
6. Perform all RST and system checks to verify performance.

E-box Service

You can perform most e-box service without removing the e-box from the system. To perform service that does require removing the e-box, you must also remove the power supply (see "Removing the Power Supply and the E-box" on page 199).

➤ Replacing E-box Circuit Boards

CAUTION

Always observe proper ESD procedures when servicing the inside of the e-box. Wear a grounded wrist strap, and work on a static-dissipating mat if possible. See "ESD Safeguards" on page 180.

To replace a circuit board in the e-box, see Figure 13-2 on page 235 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Open the door at the right rear of the lower enclosure by turning its latch counterclockwise.
3. Disconnect the token ring cable from the rear of the e-box.

CAUTION

The token ring cable connectors are easily damaged. Be gentle when connecting and disconnecting the cable.

4. Lift the handles of the two latches on the e-box rear cover, and rotate them a quarter turn. Remove the cover.
5. If the faulty board is the BPAP board, disconnect the two cables from its face before removing it.
6. Remove the faulty board.
7. Install the replacement board.
8. Reverse step 5 through step 2 to complete the procedure.
9. Perform all RST and system checks to verify performance.

➤ Replacing the Motherboard

To replace the e-box motherboard, See Figure 13-2 on page 235 to locate parts and assemblies, and complete the following procedure:

NOTE You can perform this procedure with the e-box mounted in the system, but it is easier with the e-box removed and separated from the power supply. See "Removing the Power Supply and the E-box" on page 199 and "Separating the E-box and the Power Supply" on page 200.

CAUTION Always observe proper ESD procedures when servicing the inside of the e-box. Wear a grounded wrist strap, and work on a static-dissipating mat when possible. See "ESD Safeguards" on page 180.

1. Remove the BPAP board, the demodulator board, and the two TR boards from the e-box, following the steps in "Replacing E-box Circuit Boards" on page 195.
2. Disconnect the power cables from the motherboard and the distribution board.
3. Loosen the four screws that secure each of the two septum panels in the e-box, and remove the septum panels.
4. Remove the 15 screws that secure the motherboard to the e-box center wall.
5. Tilt out the top edge of the motherboard to clear the board racks, and remove the motherboard.
6. Reverse step 5 through step 1 to install the motherboard.
7. Perform all RST and system checks to verify performance.

➤ Replacing the Distribution Board

To replace the distribution board, see Figure 13-2 on page 235 to locate parts and assemblies, and complete the following procedure:

NOTE You can perform this procedure with the e-box mounted in the system, but some steps are easier with the e-box removed and separated from the power supply. See "Removing the Power Supply and the E-box" on page 199 and "Separating the E-box and the Power Supply" on page 200.

CAUTION Always observe proper ESD procedures when servicing the inside of the e-box. Wear a grounded wrist strap, and work on a static-dissipating mat if possible. See "ESD Safeguards" on page 180.

1. Remove the BPAP board, the demodulator board, and the two TR boards from the e-box, following the steps in "Replacing E-box Circuit Boards" on page 195.
2. Disconnect the power cable from the distribution board.
3. Remove all the transducer connector modules and blank-off plates from the front of the e-box. See "Replacing Transducer Connector Modules" on page 201.

CAUTION Be careful when removing and installing the transducer connector modules, to prevent damage to the distribution board's connectors.

4. Remove the eight screws that secure the distribution board to the e-box center wall.
5. Tilt out the top edge of the distribution board and remove the board.

6. Reverse step 5 through step 1 to install the distribution board.
7. Perform all RST and system checks to verify performance.

Power Supply

The M2540A power supply is not serviceable in the field, except for replacing the fan. The power supply and the e-box are bolted together and must be removed from the system before they can be separated. Replacement power supplies are supplied with the fan and the finger guard installed.

➤ Removing the Power Supply and the E-box

To remove the power supply and the e-box from the system, see Figure 13-3 on page 237 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove the service panel at the right front of the lower enclosure by pressing down the two latches at the panel's top.
3. Remove the two screws that secure the power supply to the angle bracket at the front of the enclosure floor.
4. Remove the three screws from the bottom of the lower enclosure's right side panel, and remove the panel.
5. Disconnect all the cables from the rear of the e-box and the power supply. Mark the cable in the top outlet. It powers the PC, and that outlet is powered whenever the system power cable is plugged into a power source. If the PC is connected to one of the other outlets, it does not boot up.
6. Remove the two screws that secure the power supply to the angle bracket at the rear of the enclosure floor.
7. Carefully slide the power supply and the e-box out the side of the system.

8. Reverse step 7 through step 1 to install the power supply and the e-box in the system. Make sure the PC's power cord is in the top outlet.
9. Perform all RST and system checks to verify performance.

➤ Separating the E-box and the Power Supply

To separate the e-box from the power supply:

1. Remove the rear cover of the e-box.

CAUTION

Always observe proper ESD procedures when servicing the inside of the e-box. Wear a grounded wrist band, and work on a static-dissipating mat if possible. See "ESD Safeguards" on page 180.

2. Disconnect the control and power cables from the BPAP board, and remove the BPAP board.
3. Disconnect the power cables from the motherboard and the distribution board.
4. Remove the two screws at the bottom rear of the e-box.
5. Remove the two screws at the bottom front of the e-box.
6. Remove the four screws from the bottom of each side of the e-box.
7. Lift the e-box straight up from the power supply, while feeding the cables through the hole in the bottom of the e-box.
8. Reverse step 7 through step 1 to attach the e-box to the power supply.

Transducer Connector Modules

The screws that secure the transducer connector modules are behind the service panel on the front of the lower enclosure.

➤ Replacing Transducer Connector Modules

To replace a transducer connector module, see Figure 13-2 on page 235 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove the service panel at the right front of the lower enclosure by pressing down the two latches at the panel's top.
3. Remove the screws that secure the module bezel to the e-box, remove the bezel, and pull the module out.

CAUTION

Be careful when removing and installing the transducer connector modules, to prevent damage to the distribution board's connectors.

4. Reverse step 3 through step 1 to install a transducer connector module.
5. Perform all RST and system checks to verify performance.

Fan

The M2540A's cooling fan is attached to the front of the power supply. Replacement fans are supplied with the finger guard installed.

➤ Replacing the Fan

To remove the fan, see Figure 13-2 on page 235 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove the service panel at the right front of the lower enclosure by pressing down the two latches at the panel's top.
3. Disconnect the fan power cable from the power supply.
4. Use pliers or a small screwdriver to lift the heads of the four drive rivets that secure the fan to the power supply. Remove the fan.

NOTE Removing the pins from the drive rivets and compressing the expanding ends of the rivet bodies with pliers may ease installation.

5. Align the replacement fan for correct airflow direction (into the power supply) and connection to the power cables.
6. Reverse step 4 through step 1 to install the fan on the power supply.

Monitor

The color monitor is a critical component of the system. A monitor that does not perform properly must be replaced because it is not serviceable in the field. For information on adjusting the monitor display, see "Monitor Adjustment" on page 163.

➤ Replacing the Monitor

To remove the monitor from the system, see Figure 13-5 on page 245 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Disconnect the video monitor cable and the monitor power cable from the monitor.
3. Press up on the latch handle under the front edge of the monitor and pull the monitor forward until it stops.
4. Tilt up the front of the monitor and lift the monitor off the twivel.
5. Reverse step 4 through step 1 to install the monitor on the system.
6. Perform all RST and system checks to verify performance.

Monitor Twivel

The M2540A twivel is not adjustable. The following procedure describes how to disassemble the twivel to replace its parts.

➤ Disassembling the Twivel

To disassemble the twivel, see Figure 13-5 on page 245 to locate parts and assemblies, and complete the following procedure:

1. Remove the monitor as described in “Replacing the Monitor” on page 203.
2. Remove the twivel shoe’s two mounting screws, and remove the twivel shoe.
3. Lift the twivel base from the cart, while carefully passing the monitor power cord and the VGA cable through the hole in the twivel base. Pass the power cord through the hole first, before the video cable.

NOTE The VGA cable’s connector does not fit through one of the two holes in the twivel base. Note which hole the cables go through.

4. Remove the four screws that secure the monitor support bezel to the monitor support.
5. To reassemble the twivel assembly, reverse the previous procedure. When completing step 3, pass the VGA cable's connector through the twivel base first, before passing the power cord connector through.
6. Perform all RST and system checks to verify performance.

System Control Panel

Except for the trackball (see "Cleaning the Trackball" on page 169), the system control panel contains no serviceable parts, and is replaced as a unit.

➤ Replacing the System Control Panel

To replace the system control panel, see Figure 13-5 on page 245 to locate parts and assemblies, and complete the following procedure:

CAUTION

Always observe proper ESD procedures when servicing circuit boards. Wear a grounded wrist strap, and work on a static-dissipating mat if possible.

1. Disconnect the system power cord from the main AC supply.
2. Remove the seven long and the nine short flathead screws that secure the control panel to the control panel surround.
3. Push up on the bottom of the trackball, and lift the front edge of the control panel.
4. Disconnect the USB cable, the twisted-pair audio cables, the power cable, and the soft key ribbon cable from the control panel circuit board.
5. Remove the system control panel from the system.
6. Reverse step 5 through step 1 to install the control panel.
7. Perform all RST and system checks to verify performance.

CAUTION

When installing the system control panel, make sure that none of the cables rests directly under the control panel standoffs. The standoffs will cut any cables underneath them when the screws are tightened.

Monitor Support and Front Panel

The angular enclosure on top of the control panel surround is the monitor support. To replace the mechlok cable, lift column slides, upper cable harness, or lower enclosure top panel, you must remove the monitor support and its front panel.

➤ Replacing the Monitor Support and Its Front Panel

To replace the monitor support and its front panel, see Figure 13-5 on page 245 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove the monitor. See "Replacing the Monitor" on page 203.
3. Remove the system control panel. See "Replacing the System Control Panel" on page 204.
4. From under the control panel surround, remove the 19 screws that secure the monitor support and front panel.
5. Remove the monitor support front panel by rotating its bottom edge forward.
6. Remove the twivel assembly. See "Disassembling the Twivel" on page 203.
7. Remove the monitor support while feeding the VGA cable and the monitor power cable through the twivel base. Feed the monitor power cable through before the VGA cable.

NOTE The VGA cable connector does not fit through one of the two holes in the twivel. Note which hole the cables are in as you take the support off.

8. Reverse step 7 through step 1 to install the monitor support and its front panel.
9. Perform all RST and system checks to verify performance.

Cables

Most of the cables in the M2540A system pass through the lower enclosure's central plenum. You may have to remove the panels from the rear of the plenum when replacing a cable.

System Control Panel and Monitor Cables

Cables that connect the lower components to the system control panel and the monitor are bundled together. To replace any one of these cables, you must remove the entire bundle. The bundle includes the following cables:

Cable	Part Number	Description
VGA	M2540-69140	Connects the PC's SVGA port to the monitor
Keyboard USB	M2540-69110	Connects a USB port on the PC to the system control panel
Keyboard auxiliary power	M2540-69050	Connects the power supply to the system control panel
Keyboard audio line	M2540-69060	Connect the PC's sound board to the system control panel
Monitor power	M2540-69180	Connects the power supply to the monitor
Microphone	M2540-0457	Connects the microphone to motherboard
Speaker	M2540-69010	Connects the keyboard to the speakers
Control panel ground	M2540-69170	Connects the control top to the power supply

➤ Replacing the Upper Assembly Cable Bundle

To replace the cable bundle:

1. Disconnect the system power cord from the main AC supply.

2. Remove the monitor. See "Replacing the Monitor" on page 203.
3. Remove the system control panel. See "Replacing the System Control Panel" on page 204.
4. Remove the ties that secure the keyboard auxiliary power cable, the keyboard USB cable, and the keyboard audio line cables to the system control panel surround.
5. Remove the monitor support and its front panel. See "Monitor Support and Front Panel" on page 205.
6. Remove the four P-clips from the speaker supports.
7. Open the two service doors at the rear of the lower enclosure by turning their latches counterclockwise.
8. Disconnect the keyboard auxiliary power cable, the monitor power cable, and the control panel ground cable from the power supply.
9. Disconnect the keyboard USB cable, the keyboard audio line cables, the microphone cable, and the VGA cable from the PC.
10. Feed the lower ends of the cables into the lower enclosure central plenum, while pulling on the upper end of the cable bundle.
11. Reverse step 10 through step 1 to install the cable bundle.
12. Perform all RST and system checks to verify performance.

Detent Ring

The keyboard is locked by a latch pin that engages with a detent ring. If the detent ring is damaged, the keyboard does not lock and the detent ring must be replaced.

To replace the detent ring:

1. Disconnect the system power cord from the main AC supply.
2. Remove the monitor, keyboard, and soft key panel. See "Monitor" on page 202 and "System Control Panel" on page 204.

3. Remove the twivel base. See "Monitor Twivel" on page 203.
4. Remove the monitor mount. See "Monitor Support and Front Panel" on page 205.
5. Remove the six screws that secure the pivot latch to the top of the lift column and remove the pivot latch assembly.
6. Remove the detent ring and plastic cap.
   a. Remove the four screws that secure the plastic cap to the detent ring.
   b. Remove the four nuts that secure the detent ring to the top of the column mount.
   c. If there are two washers under each of the nuts in the previous step, these are the old style of Belleville washers. Discard them.
7. Prepare the cables to pass through the detent ring.
   a. Remove and save the P-clips and tie-wraps from the cables.
   b. Prepare the mechlock cable by loosening the cable stop bracket on the underside of the keyboard surround and removing the handle. Remove the cable end from the handle and pull the cable back through the slot in the bottom of the keyboard surround.
8. Replace the detent ring with the new one.
   a. Remove the cables from the old detent ring and plastic cap.
   b. Discard the old detent ring and replace it with the new one.
   c. Pass the cables back through the new detent ring. Be sure the pem nuts on the detent ring are facing up.
9. Orient the detent ring.
   a. Rotate the keyboard surround so that the back of the keyboard surround is pointed toward the back of the cart.

b. Point the "bump" in the outer circumference of the detent ring toward the back of the cart and slide the ring over the four threaded bolts.

10. Install one Belleville washer on each bolt. The cone-shaped side of the washer should be pointed upward.
11. Adjust the detent ring.
    a. Install the four nuts securing the detent ring.
    b. Tighten the nuts a little at a time in sequence. After the nuts are tightened completely, turn each nut counterclockwise about 1/8 of a turn.
12. Check the adjustment.
    a. Swivel the keyboard surround and verify that there is some friction and the swivel is not too loose or tight.
    b. Tighten or loosen the nuts equally as needed.
13. Install the plastic cap.
    a. Pass the cable through the plastic cap.
    b. Secure the cap to the detent ring with the four screws.
14. Verify that when the keyboard is in the normal, straight ahead position, you can rotate it 180 degrees counterclockwise and 165 degrees clockwise.
15. Install the new pivot latch assembly.
    a. Replace the six screws you removed in step 5.
    b. Verify that the latch operates properly and engages the detent ring.
16. Reinstall the mechlock cable.
    a. Pass the mechlock cable through the slot in the bottom of the keyboard surround, pass it through the cable stop bracket, and reattach the cable end to the handle.

b. Reinstall the handle.

c. Adjust the cable stop bracket as needed and secure it.

17. Reinstall the keyboard and monitor cables.

18. Dress the cables and secure in position with the P-clips and tie-wraps you saved in step 7.

NOTE Make sure the cables do not cross over each other where they pass under the keyboard. If you do not, you will not be able to fully seat the keyboard. Make sure the cables pass behind the stud at the front of the keyboard.

19. Reinstall the monitor mount and twivel.

a. Pass the cables for the monitor (SVGA and power) through the hole in the mount.

b. Pass each cable through one of the slots in the twivel and reattach the twivel to the monitor mount, using the four painted screws.

20. Reinstall the soft key panel, the keyboard, and the monitor.

a. Verify the operation of the keyboard swivel and latch.

b. Verify that the keyboard moves up and down.

c. Adjust the cable stop bracket as necessary so that when you pull the handle, you can move the keyboard up and down, and when you release the handle, the keyboard up/down movement is locked.

21. Turn on the system and verify proper operation.

- Keyboard keys and soft keys function properly.
- Doppler is audible on the system speakers.

Cart

This section contains procedures for servicing the lift column, the wheels, and the lower enclosure top panel.

➤ Replacing Cart Wheels (Caster Assemblies)

Although the front wheel assemblies on the cart are different from the rear wheels (front wheels have swivel locks and brakes, rear wheels do not lock), the replacement procedure for all wheels is the same.

Each cart wheel is supplied as a caster assembly. The front caster assembly includes the integral brake and swivel lock.

WARNING

The cart is heavy. Use caution while performing this procedure.

To replace a caster assembly:

1. Disconnect the system power cord from the main AC supply.
2. Secure the wheel locks.
3. Chock both front wheels if a rear wheel is being replaced, or chock both rear wheels if a front wheel is being replaced.

   The chocks are a safety measure, to prevent the cart from rolling during this procedure.
4. Carefully lift the front or the back of the cart (depending on which wheel you are replacing), and slide a support block under the front or rear edge of the lower enclosure to hold both wheels at that end *slightly* off the floor. Make sure the cart is stable in this raised position.
5. Use a 13-mm wrench to remove the four bolts that secure the wheel assembly to the bottom of the cart base, and remove the wheel.
6. Reverse step 5 through step 1 to install the new wheel assembly.

➤ Replacing the Top Panel of the Lower Enclosure

You can remove and install the top panel of the lower enclosure without taking out the lift column or the upper cable bundle.

To replace the top panel of the lower enclosure, see Figure 13-3 on page 237 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove all the peripherals from the top of the lower enclosure.
3. Remove the system control panel. See "Replacing the System Control Panel" on page 204.
4. Unfasten the height release handle and the cable clamp, and remove them from the cable.
5. Remove the monitor support and its front panel. See "Monitor Support and Front Panel" on page 205.
6. Remove all the cable clamps and tie-wraps from the cables.

   Note that the power and USB cables loop forward of the standoffs, and make note of the positions of the cable ends.
7. Remove the six screws that secure the pivot latch to the top of the lift column.
8. Remove the 11 screws that secure the system control panel surround to the column, and remove the surround.
9. Remove the PC. See "Removing the PC from the System" on page 194.
10. Remove the e-box and the power supply. See "Removing the Power Supply and the E-box" on page 199.
11. Remove the peripherals strap.
12. Remove the 10 nuts that secure the top panel to the lower enclosure.
13. Lift the top panel of the lower enclosure and tilt it to clear the lift column top flange.

14. Reverse step 13 through step 1 to install the lower enclosure top panel.
15. Perform all RST and system checks to verify performance.

Lift Column

The lift column has four replaceable components:

- The gas spring
- The mechlok assembly
- The mechlok cable
- Three slide assemblies

The column is also available as an assembly, including all the components listed in the preceding list. After reassembling the system, perform all RST and system checks to assure proper performance.

Preparation

➤ **Preparing the System for Servicing the Lift Column**

The procedures for replacing the lift column components are the most complex of the field service procedures. Because the lift column supports the weight of the upper system, you must complete the following procedure before performing any service to the column.

WARNING

To prevent personal injury and damage to the system, complete this procedure before servicing the lift column.

To prepare the system for lift column servicing, see Figure 13-4 on page 242 and Figure 13-3 on page 237 to locate parts and assemblies, and complete the following procedure:

1. Disconnect the system power cord from the main AC supply.
2. Remove all peripherals from the top of the lower enclosure.

3. Remove the monitor. See "Replacing the Monitor" on page 203.
4. Remove the PC. See "Removing the PC from the System" on page 194.
5. Remove the e-box and power supply. See "Removing the Power Supply and the E-box" on page 199.
6. Remove the cable hook on the front of the lower enclosure.
7. Remove the four screws on each side of the lower enclosure front center panel and the two screws at the bottom of the panel, and remove the panel.
8. Extend the lift column to its highest position.

NOTE When you are replacing only the gas spring, step 9 and step 10 are not required.

9. Remove the system control panel. See "Replacing the System Control Panel" on page 204.
10. Remove the monitor support and front panel. See "Monitor Support and Front Panel" on page 205.
11. Rotate the control panel surround to face the rear of the system.
12. Carefully lay the system down on its rear side.

Gas Spring

➤ Replacing the Gas Spring

The gas spring supports the weight of the upper assembly when the system is upright. Before working on the gas spring, you must relieve the weight.

WARNING

Before beginning this procedure, complete "Preparation" on page 213, to prevent bodily injury and damage to the system.

To replace the gas spring:

1. Complete "Preparation" on page 213.
2. Remove the two screws that secure the upper gas spring bracket to the column.
3. Swing the top of the gas spring out, and unscrew the gas spring shaft from the pivot at the bottom of the cart.
4. Unclip and remove the retaining spring from the ball-cup end of the gas spring.
5. Pull the gas spring's cup end off the ball stud on the gas spring upper bracket.
6. Reverse step 5 through step 1 to install the gas spring.
7. Perform all RST and system checks to verify performance.

Mechlok and Cable

The mechlok assembly locks the lift column at any height in the column's range. The mechlok is controlled by a cable connected to a handle under the front of the system control panel surround. You can replace the cable without completely removing the mechlok, and you can replace the mechlok mechanism without removing the cable from the system.

➤ Replacing the Mechlok and Cable

WARNING

Before beginning this procedure, complete "Preparation" on page 213, to prevent bodily injury and damage to the system.

To remove the mechlok and cable:

1. Complete "Preparation" on page 213.
2. Remove the three screws that secure the mechlok handle to the control panel surround, and unclip the handle from the cable end.

3. Remove the two screws that secure the cable clamp to the control panel surround, and unclip the clamp from the cable outer sheath.
4. From under the bottom of the system, remove the two screws that secure the gas spring and mechlok lower bracket to the floor of the lower enclosure.
5. Remove the two screws that secure the upper gas spring bracket to the column.
6. Grasp the ring on the mechlok locking pin, and pull the pin out of the column. Remove the mechlok and gas spring.
7. Slide the cable locking clip off the tab on the mechlok to remove the cable.
8. If you are replacing the cable, pull the upper end of the cable up through the control panel surround and down through the lift column.
9. If you are replacing the mechlok, remove the retaining clip from the pivot pin in the gas spring and the mechlok lower bracket, and remove the pin.
10. Reverse step 9 through step 1 to install the mechlok and cable.
11. After installation and righting of the system, adjust the position of the cable clamp under the control panel surround to provide proper locking and unlocking.
12. Perform all RST and system checks to verify performance.

Slides

Each of the three lift column slide assemblies consists of an inner slide mounted on the lift column and an outer slide mounted in the lower enclosure plenum.

➤ Replacing the Slides

WARNING

Before beginning this procedure, complete "Preparation" on page 213, to prevent bodily injury and damage to the system.

To replace the lift column slides:

1. Complete "Preparation" on page 213.
2. Remove the I/O panel and the anchor panel for the peripheral strap.
3. Remove the two screws at the bottom of the rear center panel, near the door hinges, and remove the panel and the doors.
4. Remove the gas spring and mechlok assembly. See "Replacing the Mechlok and Cable" on page 215.

   When replacing slides, it is not necessary to remove the mechlok cable, or to disconnect the mechlok or the gas spring from their lower bracket.
5. Push the lower ends of the upper cable bundle into the plenum, to prevent their snagging in the plenum openings.
6. Stand the system upright.
7. Remove the four nylock nuts that secure the lift column surround plate to the top panel of the lower enclosure.
8. Carefully pull the lift column out of the lower enclosure.

CAUTION

Make sure none of the cables snags in the lower enclosure.

9. Remove the four nylock nuts that secure each outer slide to the lower enclosure plenum, and remove the outer slides from the lower enclosure.

NOTE The stop on each outer slide goes toward the bottom of the system.

10. Remove the four screws that secure each inner slide to the lift column, and remove the inner slides.
11. Reverse step 10 through step 1 to install the lift column slides.

NOTE Do not fully tighten the slide fasteners until the column is in the slides.

CAUTION

Use great care to align the slides correctly when installing the lift column, to avoid damaging the ball carriers.

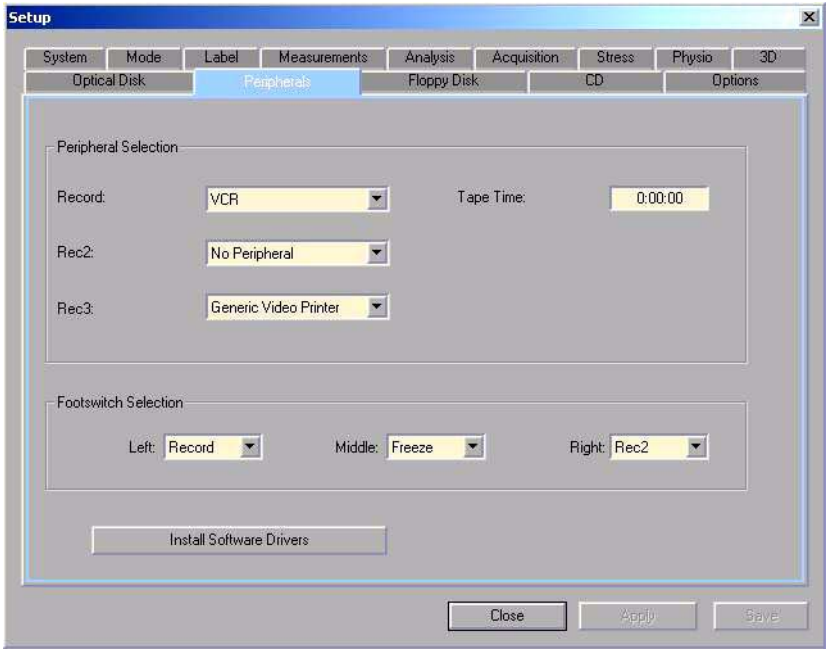
12. Run the column through its entire range of motion. If it binds, loosen all the outer slide mounting nuts, run the column through its entire range of motion, and then tighten the nuts.

Updating Peripherals Drivers

To update the drivers for the peripherals:

1. Insert the COTS CD in the CD drive.
2. On the Setup window, click the **Peripherals** tab (Figure 10-5).

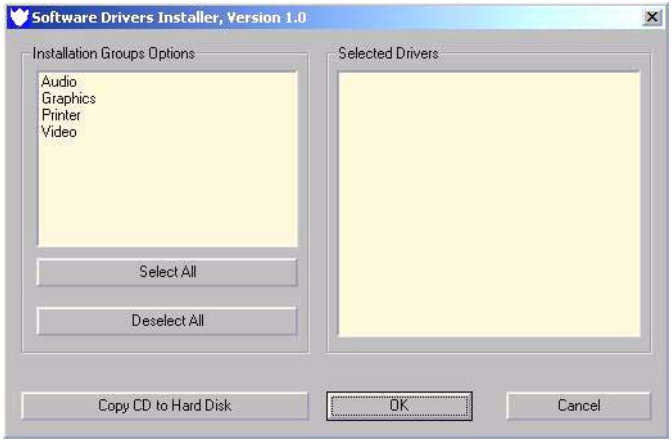
Figure 10-5 Setup Window (Peripherals)



3. Click **Install Software Drivers**.

The Software Drivers Installer window appears.

Figure 10-6 Software Drivers Installer Window



4. Click **Copy CD to Hard Disk**.
5. Remove the COTS CD.

   After the copy process is completed, Copy Complete is displayed above the Copy CD to Hard Disk button.

To use the newly copied drivers, you must install them:

1. In the Software Drivers Installer window, select the driver groups to install or click **Select All** to install all drivers.
2. Click **OK**.

   A Video Format window appears.
3. Select the appropriate video format and click **OK**.

While the drivers are updating, a cmd.exe window appears several times. When the process is complete the Setup menu appears.

4. Close the Setup menu.

11 Cabling

Parts List

Table 11-1 lists the cables in the M2540A. The cables may also be listed in assembly parts lists in Section 13, "Parts."

Table 11-1 Cables

Description	Part Number	Qty	Connections	
			From	To
Cart to external AC power cable	M2540-69120	1		
PC (DP) power cable	8120-2572	1	Power Supply	PC
Internal LAN cable	M2540-69130	1	PC Motherboard I/O	I/O Panel
Composite video RCA cable	M2540-69140	1	Video Capture Bd.	I/O Panel
Trigger miniphone cable	M2540-69150	1	APIO board	I/O Panel
Printer USB cable	M2540-69100	2	USB port	Printer
Peripheral power cable (IEC)	8120-2572	2	Power supply	Peripheral Tray
I/O panel foot switch cable	M2540-69160	1	APIO Bd.	I/O Panel
Token ring cable	M2540-69000	1	E-box	APIO Bd.
Ground cable	M2540-69170	1	Control top	Power Supply
System cable harness	M2540-69220	1		
Monitor power cable	M2540-69180	1	Power Supply	Monitor
Monitor video cable	M2540-69040	1	Graphics Bd.	Monitor
Speaker cable	M2540-69010	1	Keyboard	Speakers
Cable, USB 10 ft.	M2540-69110	1	PC Motherboard I/O	Keyboard

Table 11-1 Cables (Continued)

Description	Part Number	Qty	Connections	
			From	To
Microphone cable	M2450-69230	1	Microphone	PC Motherboard I/O
Keyboard auxiliary power cable	M2540-69050	1	Power Supply	Keyboard
Keyboard line audio cable	M2540-69060	1	PC Motherboard I/O	Keyboard
PCI Serial Cable Assembly (internal to PC)	M2450-67220	1	PC Motherboard Com 2	Rear PC/daughter bd. bracket slot
External RS-232 cable	M2450-69240	1	PC Rear Panel	Off-line analysis station
VCR video in/out cable	M2540-69070	2	VCR	Video Capture Bd, TVIEW Gold Bd.
VCR audio in/out cable kit, includes:	M2540-69200	1	VCR	Sound Card
Audio in/out cable	M2540-69202			
Audio in/out cable	M2540-69204			
VCR serial cable	M2540-69090	1	VCR	PC Serial port (Com 1)
Power cords				
UK power cord	M2540-60900	1		
Australia power cord	M2540-60901	1		
Europe power cord	M2540-60902	1		
US, Canada, & Japan power cord	M2540-60903	1		
Switzerland power cord	M2540-60906	1		
Denmark power cord	M2540-60912	1		
South Africa power cord	M2540-60917	1		

Table 11-1 Cables (Continued)

Description	Part Number	Qty	Connections	
			From	To
Israel power cord	M2540-60919	1		
Argentina power cord	M2540-60920	1		
PRC power cord	M2540-60922	1		
Physio option cables				
Physio option USB cable	M2540-69020	1		
Physio option trigger cable	M2540-69030	1		
3-Lead AAMI grabber set	M1603A			
3-Lead AAMI trunk cable	M1500A			
3 Lead AAMI mini-clip set	M1609A			
3-lead IEC trunk cable	M1510A			
Accessory cables				
Cable, LAN 10 ft.	M2540-69080		Rear I/O panel	Network wall jack
USB cable 10 ft.	M2540-69110		PC rear panel	Plain paper printer
Serial DB9F-DB9F cable	M2450-69240	1	Rear PC/daughter bd. bracket slot	Peripheral Tray

12 Configuration

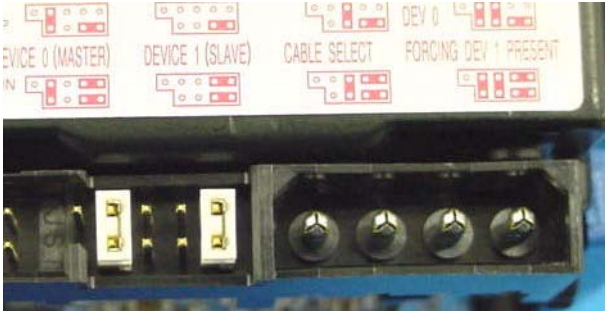
Disk Drive Settings

The jumper positions and switch settings of the drives in the M2540A depend on the manufacturer of the drives.

Hard Drive Jumpers

Figure 12-1 shows typical hard disk drive jumper positions. Examine the drive itself for information on the correct settings. The hard disk drive is the only device on the primary IDE, and is usually set to MASTER or SINGLE.

Figure 12-1 Hard Disk Drive Jumper Settings



CD Drive Jumpers

Figure 12-2 shows typical CD-RW drive jumper positions. Set the jumper to the MASTER position on the secondary IDE.

Figure 12-2 CD-RW Drive Jumper Position

MOD Drive Jumpers

Set the MOD drive jumpers to SLAVE on the secondary IDE.

VCR Switch Settings

The VCR's switches must be set to the following positions:

- Audio Out left switch: **Mix**
- Audio Out right switch: **Norm**
- Input: **S-Video**
- S-VHS: **Auto**
- Menu: **Off**
- Mode Lock: **Off**

Sony B/W Printer Dip Switch Settings

On the Sony black and white printer, all switches should be in the down position (ON).

BIOS Settings

To reset the BIOS after changing the battery or motherboard.

1. Reboot the system.
2. As the system boots up, press the **Preset** key repeatedly, until the BIOS screen opens.
3. Set the BIOS default settings by pressing the **Option** (I) key and in the box that appears, selecting **Yes**, and then pressing **Return**.
4. Set the system date and time to the local time by pressing the down arrow key until **System Time** is highlighted. Refer to the descriptions in the right pane to make the appropriate changes.
5. Press the right arrow until **Advanced** is highlighted, press the down arrow until **Boot Configuration** is highlighted, press **Return**, and then set **Plug and Play = Yes**.
6. Press **Hx** to return to the Advanced menu.
7. Press the down arrow until **Peripheral Configuration** is highlighted and press **Return**.
8. Refer to the descriptions in the right pane to set the following:

NOTE The Enter key that is referred to in the right pane is the Return key on the EnVisor QWERTY keyboard.

- **Serial Port A = Enabled**
- **Serial Port B = Enabled**
- **Parallel Port = Disabled**
- **Legacy USB Support = Enabled**

9. Press **Hx** to return to the Advanced menu, press the right arrow until **Boot** is highlighted, and then press **Return**.

10. Under the **Boot** menu, set: **USB Boot = Disabled**.
11. Press the down arrow until **Boot Device Priority** is highlighted and then press **Return**.
12. Refer to the descriptions in the right pane to set the following:
    - **First Boot Device = CD Drive**
    - **Second Boot Device = Hard Drive**
    - **Third Boot Device = Disabled**
    - **Fourth Boot Device = Disabled**
13. Press **Hx** to return to the Boot menu, press the left arrow until **Power** is highlighted.
14. Press the down arrow until **After Power Failure** is highlighted.
15. Refer to the descriptions in the right pane to set it to **Stay Off**.
16. Press the **Option** (2) key, highlight **Yes**, and then press **Enter** to save the BIOS setting.

    The system reboots.

13 Parts

Overview

This section contains lists of the M2540A's parts, supplies, and accessories available for use with the system, and information on ordering parts, accessories, and supplies."Ordering Parts" on page 229

- "Major Assemblies" on page 231
- "Transducer Connector Modules" on page 231
- "Internal PC" on page 232
- "E-box and Power Supply" on page 235
- "Lower Assembly" on page 237
- "Lift Column Assembly" on page 242
- "Upper Assembly" on page 245
- "Top Shelf" on page 248
- "Software" on page 250
- "Physio Option Parts" on page 251
- "Optional Peripherals" on page 251
- "Supplies and Accessories" on page 252

For Transducer part numbers, see Section 14, "Transducers." For more information about cable part numbers, see Section 11, "Cabling."

Ordering Parts

Address all parts orders or inquiries to your local Philips Sales and Service office. Always specify the correct part number or exchange number for the assembly or component being ordered, as well as the serial and revision numbers of the system in which the assembly is being installed.

To learn more about transducer parts, see the *Philips EnVisor Series Transducer Guide*.

New Parts

Be sure to specify the correct subassembly or component part number, as listed throughout this section.

Exchange Parts

Some circuit boards, transducers, and OEM peripherals are available as *exchange* items (repaired or refurbished), at reduced cost. Exchange item part numbers are different from original equipment part numbers.

System Serial Number and Revision Level

When ordering any new or exchange part, be sure to include the system serial number and the software revision prefix (for example, B.0). The serial number is on the system ID label, on the rear of the cart. The ID label also identifies installed system options.

➤ Finding Software Revision Numbers

To find software revision numbers:

- Check the *Philips EnVisor Series Help*
- Run the RST application.
  a. Click the **Info** tab.
  b. Click **System**. See "System Information" on page 145.

Major Assemblies

Table 13-1 lists the major assemblies of the M2540A, and the drawings that show them.

Table 13-1 Major Assemblies

Description	Drawing and Page
PC	Figure 13-1 on page 232
Power supply	Figure 13-2 on page 235
E-box	Figure 13-2 on page 235
Upper assembly	Figure 13-5 on page 245
Lower assembly	Figure 13-3 on page 237
Lift column	Figure 13-4 on page 242

Transducer Connector Modules

Table 13-2 lists the available transducer connector modules and their part numbers.

Table 13-2 Transducer Connector Modules

Description	Part Number	Qty
Cannon (Standard) transducer connector module	M2540-62100	1
AdvanceVision (Cartridge) transducer connector module	M2540-62000	1
Pencil transducer connector module	M2540-62200	1
Blank module	M2540-62010	1
Cannon Switchboard	M2540-60080	1

Internal PC

Figure 13-1 shows the replaceable components of the M2540A's PC. The numbers refer to Table 13-3, on page 233.

Figure 13-1 Internal PC Components

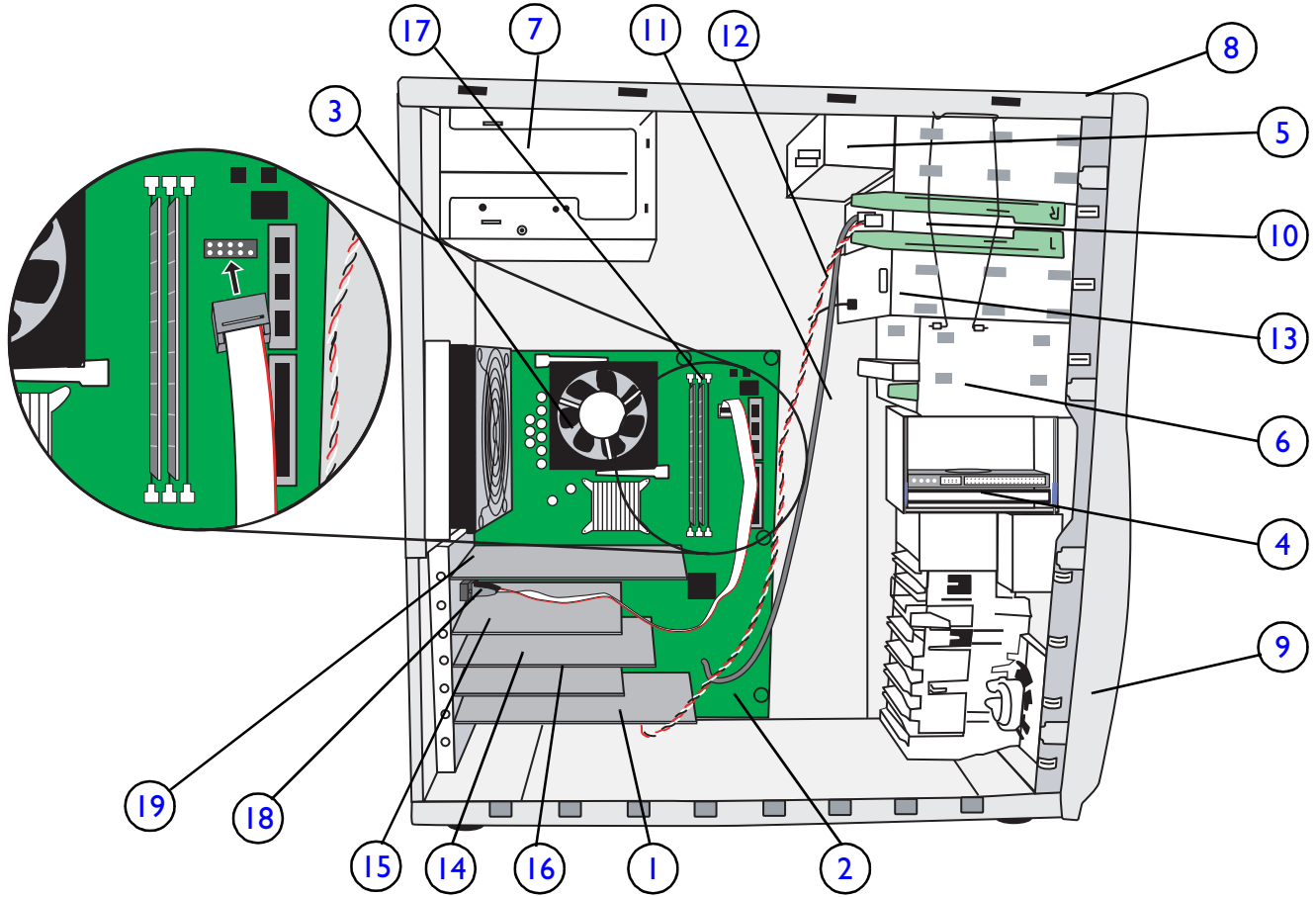


Table 13-3 lists the replaceable components of the internal PC shown in Figure 13-1. Numbers in the # column are the item numbers on the drawing. A dash (—) in the # column means the part is not numbered on the drawing.

At PC Revision C.0, some part numbers changed. The old part numbers and their compatibility are shown in Table 13-3.

Table 13-3 Internal PC Components

#	Description	Pre-Rev. C PC Part Number[1]	Part Number	Qty	Reference
PC			M2540-67000	1	Figure 13-3
1	APIO board		M2540-60030	1	
2	PC motherboard		M2540-67110	1	
3	CPU	M2540-67140	M2540-67141[2]	1	
4	Hard disk drive	M2540-67100	M2540-67101[2]	1	
5	CD-RW drive	M2540-67130	M2540-67131[2]	1	
6	Floppy disk drive		M2540-67120	1	
7	PC power supply		M2540-67150	1	
8	PA 810 enclosure		M2540-67170	1	
9	PC bezel		M2540-67210	1	
10	Physio module		M2540-62300	1	
11	Physio USB cable		M2540-69020	1	Table 11-1
12	Physio trigger cable		M2540-69030	1	Table 11-1
13	MOD drive	M2540-80100	M2540-80105 [2]	1	

Table 13-3 Internal PC Components (Continued)

#	Description	Pre-Rev. C PC Part Number[1]	Part Number	Qty	Reference
14	Video converter board		M2540-80070	1	
15	Video capture board		M2540-80080	1	
16	Sound card	M3150-60020	M2540-67240 [2]	1	
—	Ribbon Cable kit		M2540-67160	1	
—	256 MB memory module		M2540-67180	1	
17	512 MB memory module		M2540-67190	2	
—	Drive bay blank cover kit		M2540-67200	1	
—	Screw, 6-32 x 5/8, panhead		2360-0123	3	
18	PCI serial cable assembly		M2540-67220	1	
19	Graphics card		M2450-67230	1	

1.Old part is compatible with PC Rev C.

2. New part is backwards compatible with pre-Rev. C.0 part.

E-box and Power Supply

Figure 13-2 shows the system power supply and the components of the e-box listed in Table 13-4. The power supply contains no replaceable parts.

Figure 13-2 E-box and Power Supply Components

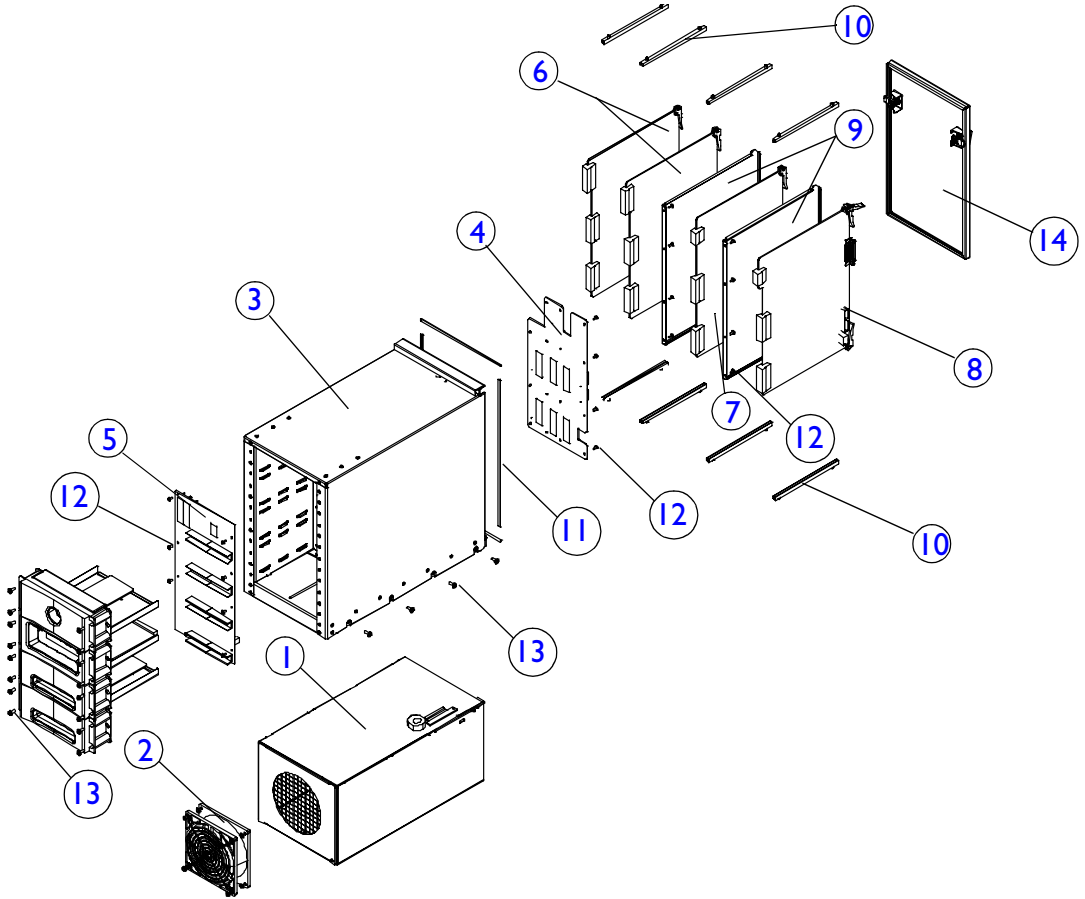


Figure 13-4 lists the components of the power supply and e-box assembly shown in Figure 13-2. Numbers in the # column are the item numbers on the drawing. A dash (—) in the # column means the part is not numbered on the drawing.

Table 13-4 Power Supply and E-box Assembly Components

#	Description	Part Number	Exchange Part Number	Qty	Reference
1	Power supply	M2540-66000	M2540-66008	1	
2	Cooling fan	M2540-66010		1	
3	E-box assembly	M2540-64000		1	Does not include circuit boards
4	Motherboard	M2540-60000		1	
5	Distribution board	M2540-60010		1	
6	TR board	M2540-60040	M2540-60048	2	
7	Demodulator board	M2540-60050	M2540-60058	1	
8	BPAP board	M2540-60060	M2540-60068	1	
9	Chassis septum	M2540-00040		2	
10	Card guide	4040-2551		8	
11	RFI shielding kit	M2540-86040		1	
12	M3 x 6-mm screw	0515-0430		27	
13	M4 x 10-mm screw	M2540-80322		16	
14	e-box door assembly	M2540-64010		1	

Lower Assembly

Figure 13-3 shows the components of the lower assembly listed in Table 13-5.

Figure 13-3 Lower Assembly

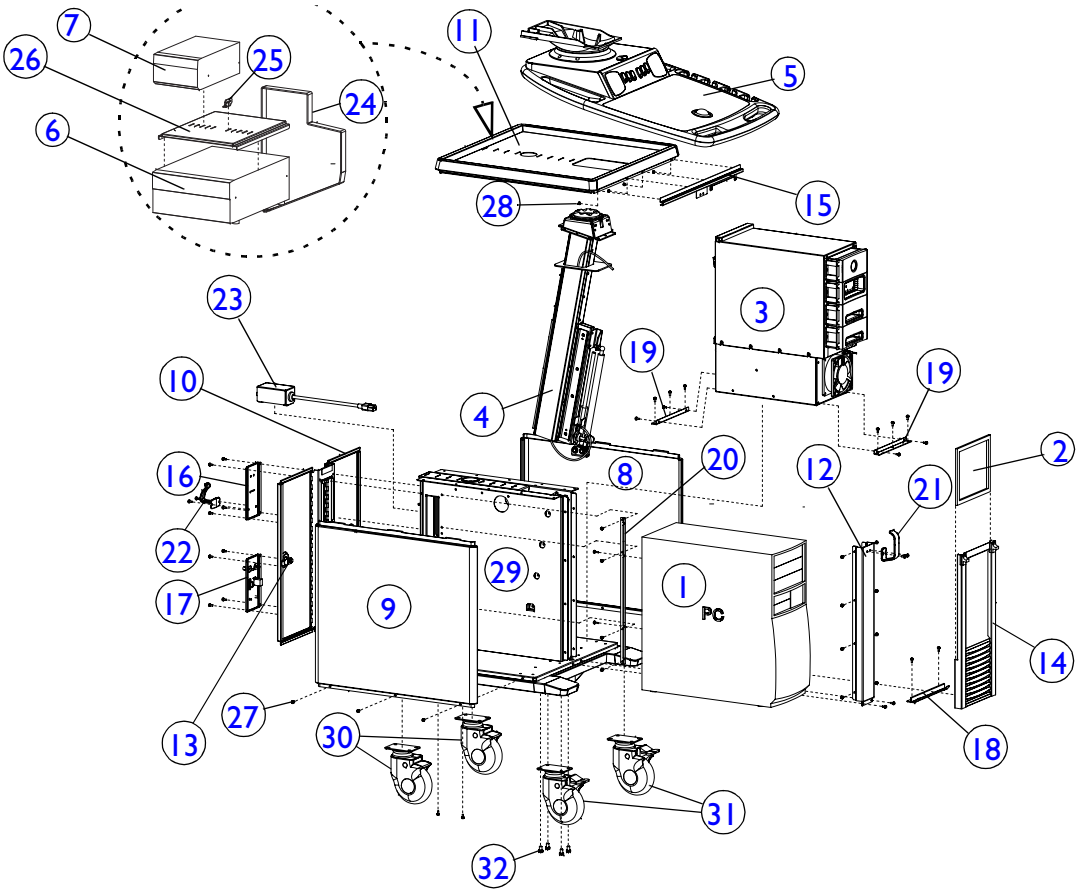


Table 13-5 lists the components of the lower assembly shown in Figure 13-3. Numbers in the # column are the item numbers on the drawing. A dash (—) in the # column means the part is not numbered on the drawing.

Table 13-5 Lower Assembly

#	Description	Part Number	Qty	Reference
Cart assembly		M2540-65000	1	
1	PC	M2540-67000	1	Table 13-3
2	Air filter	M2540-80050	1	
3	E-box and power supply	—	1	Bolted together, see Figure 13-2
4	Column assembly	M2540-65100	1	Table 13-6
5	Control top	—	1	Figure 13-5
6	VCR	—	1	Table 13-11
7	Printer	—	1	Table 13-11
8	Side panel, right	M2540-00400	1	
9	Side panel, left assembly	M2540-65190	1	
10	Rear panel assembly	M2540-65170	1	Includes rear doors
11	Cart top	M2540-00420	1	
12	Center column, front	M2540-00370	1	
13	Latch, rear door	1390-1326	2	

Table 13-5 Lower Assembly (Continued)

#	Description	Part Number	Qty	Reference
14	Front panel	M2540-00440	1	
15	Top front trim	M2540-00590	1	
16	Upper I/O panel	M2540-00660	1	
17	Lower I/O panel	M2540-00670	1	
—	LAN bulkhead connector	1252-6178	1	
—	Grounding stud	1251-5964	1	
—	I/O panel trigger cable	M2540-69150	1	Table 11-1
—	I/O panel foot switch cable	M2540-69160	1	Table 11-1
—	Internal LAN cable	M2540-69130	1	Table 11-1
—	Composite video cable	M2540-69140	1	Table 11-1
18	Cart front panel bracket	M2540-00620	1	
19	Power supply bracket	M2540-00530	2	
20	PC bracket	M2540-00600	1	
21	Transducer cable hook	M2540-40690	4	
22	Cable hook, rear	M2540-40680	1	
23	External power plug and cable	M2540-69120	1	
24	Peripheral strap	77922-80290	1	
25	Strap bracket kit	M2540-86020	1	
—	Color printer tray kit	M2540-86010	1	
26	VCR tray	M2540-00810	1	
—	Printer spacer	M2540-40750	4	

Table 13-5 Lower Assembly (Continued)

#	Description	Part Number	Qty	Reference
—	Nylon bushing, 2-in	0040-0951	1	
—	VCR option video in/out cable	M2540-69070	2	
—	VCR option audio in/out cable	M2409-69200	1	
—	VCR option serial cable	M2540-69090	1	
—	Printer USB cable	M2540-69100	2	
—	Peripheral power cable (IEC)	8120-2572	3	Table 11-1
—	Token ring cable	M2540-69000	1	
—	Ground cable	M2540-69170	1	
—	Power cord retainer	M2540-40700	1	
27	M4 x 10-mm Phillips locking screw	0515-2859	4	
—	M3 x 12-mm screw	0515-0664	10	
28	M4 nylock nut	0535-1029	12	
—	Foam strip	M2540-80120	4	
29	Center cart assembly	M2540-65140	1	
30	Plain swivel caster	M2540-80240	2	
31	Locking swivel caster	M2540-80250	2	
32	M8 x 16-mm hex locking bolt	0515-2466	16	
—	M4 x 10-mm screw with washer	M2540-80322	39	
—	M6 lock nut	0535-1030	4	
—	M5 x 16-mm screw	0515-0671	1	
—	M5 plastic hex nut	0535-0090	1	

Table 13-5 Lower Assembly (Continued)

#	Description	Part Number	Qty	Reference
—	Nameplate BASIC	M2540-83010	1	
—	Nameplate Performance	M2540-83020	1	
—	System Serial Overlay Label	M2540-83030		
—	Performance label strip	M2540-83040	1	
—	Nameplate CV	M2540-83050	1	
—	Nameplate CV performance	M2540-83060	1	

Lift Column Assembly

Figure 13-4 shows the components of the lift column assembly listed in Table 13-6.

Figure 13-4 Lift Column

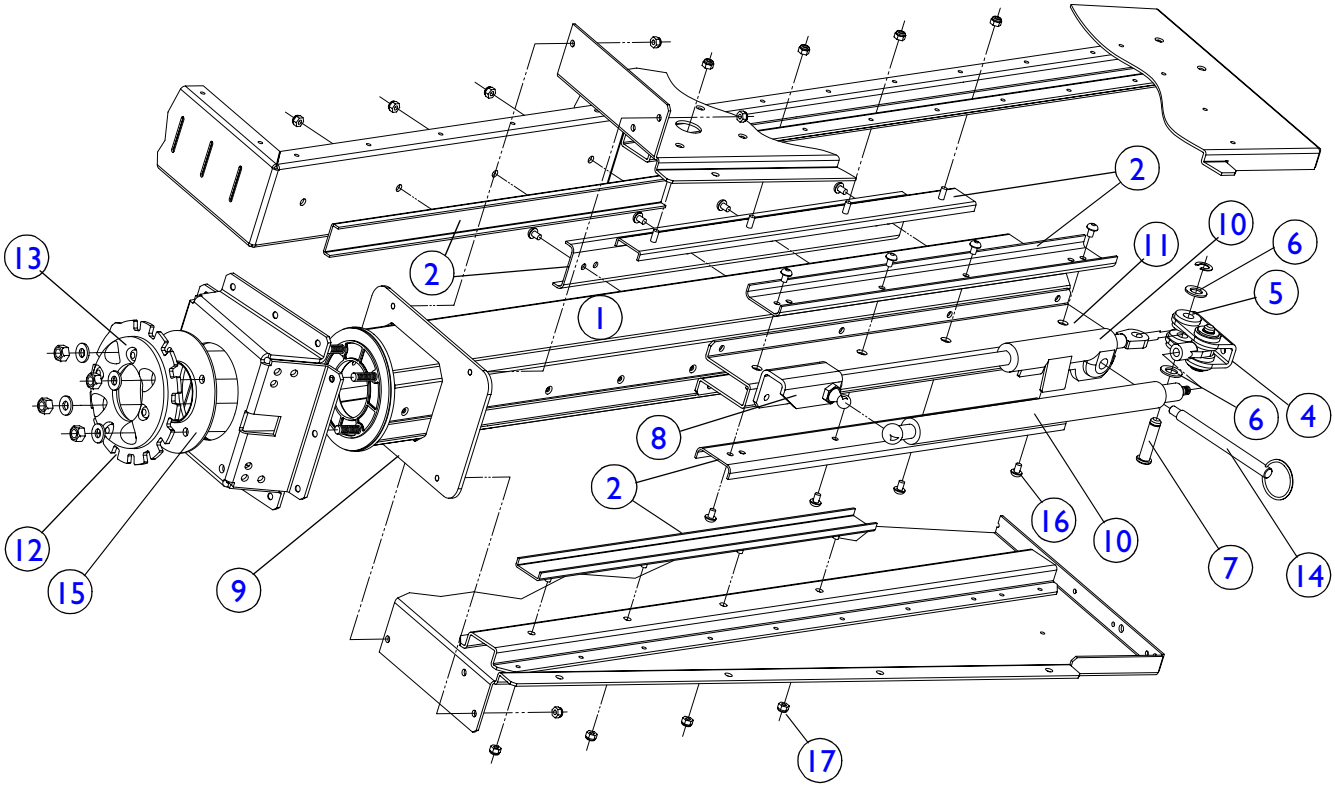


Table 13-6 lists the components of the lift column assembly shown in Figure 13-4. Numbers in the **#** column are the item numbers on the drawing. A dash (**—**) in the # column means the part is not numbered on the drawing.

Table 13-6 Lift Column Components

#	Description	Part Number	Qty	Reference
1	Column assembly	M2540-65100	1	
2	Slide assembly	M2540-65030	3	
3	Gas spring bracket	M2540-00310	1	
—	Mechlok bracket hardware kit	M2540-65180	—	Includes items 4, 5, 6, 7, and strut eyelet
4	Mechlok bracket	—	1	Part of M2540-65180
5	Grommet, 5/16-in ID	—	4	Part of M2540-65180
6	Flat washer, 5/16-in	—	4	Part of M2540-65180
7	Clevis pin	—	2	Part of M2540-65180
8	Gas strut assembly	M2540-80020	1	
9	Column cover	M2540-00430	1	
10	Mechlok	M2540-80030	1	
11	Slide bracket, front	M2540-00320	1	
—	Mechlok cable	M2540-80035	1	

Table 13-6 Lift Column Components (Continued)

#	Description	Part Number	Qty	Reference
—	Friction ring	M2540-80010	2	
—	Belleville washer	2190-1222	4	
12	Detent ring	M2540-00270	1	
13	Cable protector cap	M2540-40710	1	
14	Quick release pin and ring	1480-1141	1	
15	Pivot mount	M2540-00230	1	
16	M4 x 6-mm panhead screw	0515-4655	12	
—	M4 x 10-mm screw with washer	M2540-80322	12	
—	M4 x 10-mm screw with washer, mushroom	M2540-80320	10	
—	M4 x 10-mm screw with washer, light gray	M2540-80325	2	
17	M4 lock nut	0535-1029	12	

Upper Assembly

Figure 13-5 shows the components of the upper assembly listed in Table 13-7.

Figure 13-5 Upper Assembly

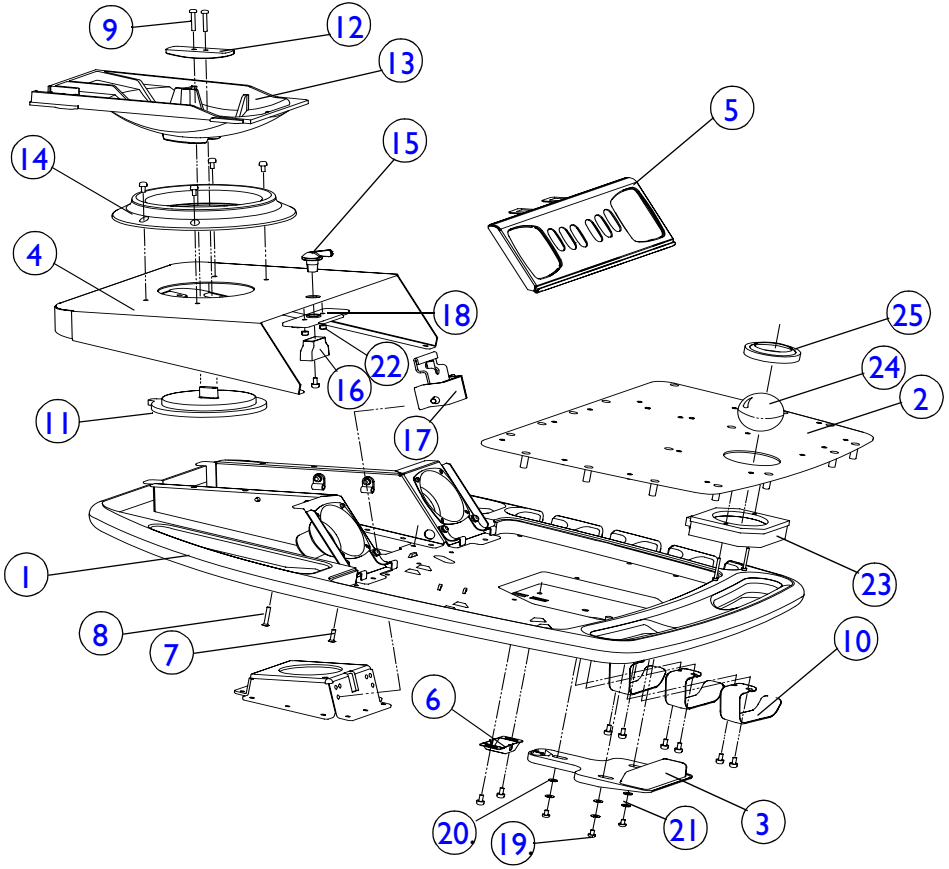


Table 13-7 lists the components of the upper assembly shown in Figure 13-5. Numbers in the # column are the item numbers on the drawing. A dash (—) in the # column means the part is not numbered on the drawing.

Table 13-7 Upper Assembly Components

#	Description	Part Number	Exchange Part Number	Qty	Reference
1	Top shelf assembly			1	Figure 13-6 on page 248
—	FIMI monitor, mushroom	M2540-66500	M2540-66508	1	
2	System control panel (keyboard)	M2540-40100	M2540-40108	1	
3	Height release handle	M2540-40560		1	
4	Monitor support	M2540-00210		1	
5	Monitor support front panel assembly	M2540-65120		1	
6	Cable stop bracket	M2540-00550		1	
7	M4 x 16-mm flathead screw	0515-4620		12	
8	M4 x 25-mm flathead screw	0515-4622		25	
9	M4 x 25-mm panhead screw	0515-2860		2	
10	Transducer cable hook	M2540-40690		3	
—	Twivel assembly				
11	Twivel ring	M2540-40740		1	
12	Twivel shoe	M2540-40730		1	
13	Monitor mount (twivel base)	M2540-40630		1	

Table 13-7 Upper Assembly Components (Continued)

#	Description	Part Number	Exchange Part Number	Qty	Reference
14	Twivel hat	M2540-40610		1	
—	Pivot mount assembly			1	
—	Pivot mount	M2540-00230		1	
15	Pivot knob	M2540-40550		1	
16	Latch cam	M2540-40590		1	
17	Pivot latch assembly	M2540-65150		1	
18	Latch bearing	M2540-40600		1	
19	M4 x 6-mm Phillips screw	0515-4655		3	Used with items 20, 21
20	Delrin flat washer	3050-2184		3	
21	Precision flat washer 0.171-in ID	3050-2186		3	
22	M4 nylock nut	0535-1029		2	
—	M4 x 10-mm screw with washer	M2540-80322		2	
23	Trackball assembly	M2540-80200		1	Includes items 24 and 25
24	Trackball	M2540-80210		1	
25	Trackball ring	M2540-80220		1	
—	Control panel replacement knob kit	M2540-86070		—	
—	Rotary encoder	M2540-40210		7	
—	Cable tie	1400-0401		12	

Top Shelf

Figure 13-6 shows the components of the upper assembly listed in Table 13-8.

Figure 13-6 Top Shelf

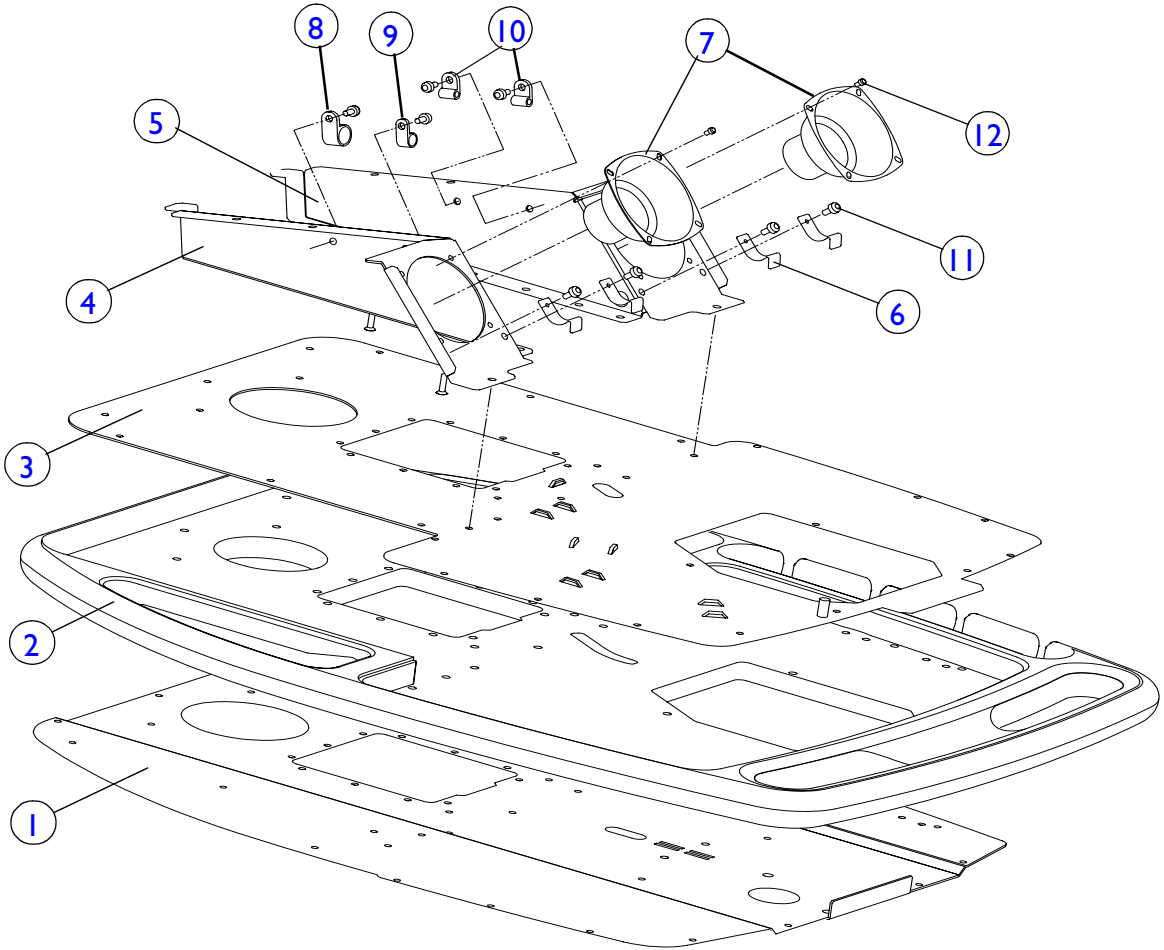


Table 13-8 lists the parts shown in Figure 13-6. Numbers in the # column are the item numbers on the drawing. A dash (—) in the # column means the part is not numbered on the drawing.

Table 13-8 Top Shelf Components

#	Description	Part Number	Qty	Reference
1	Bottom sheet	M2540-00160	1	
2	Keyboard surround	M2540-40500	1	
3	Top sheet	M2540-00150	1	
4	Speaker support, left	M2540-00190	1	
5	Speaker support, right	M2540-00200	1	
6	Front panel retainer clip	M2540-00880	4	
7	Speaker	M2540-80230	2	
8	P-clip, 1 in		2	Part of M2540-86050
9	P-clip, 5/8 in		1	Part of M2540-86050
10	P-clip, 3/16 in		2	Part of M2540-86050
11	M4 x 10-mm Phillips screw	M2540-80322	4	Equivalent to 0515-0380
12	M3 x 6-mm Phillips screw	0515-0430	8	
—	Speaker foam	M2540-80110	4	

Software

Table 13-9 lists the part numbers for the M2540A's software CDs.

Table 13-9 M2540A Software CDs

Description	Rev. A.1.1 Part Number	Rev. B.0 Part Number	Comments
Software CD Set	M2540-86103	453563495201	Contains all CDs necessary to install Rev. B.0 on an EnVisor system (Operating System CD, Ultrasound Application CD, and COTS CD).
Ultrasound application software, CD	M2540-81002-01	453563495161	
Operating System, CD	M2540-82501-01	453563495141	
COTS CD, Rev. COTS.04	M2540-82002-01	453563495121	

The COTS CD contains the following drivers:

- Audio
  - Creative Sound Blaster
  - Intel Integrated audio
- Graphics—ATI Radeon 7000
- Video
  - Tview Gold PCI
  - Hauppauge Impact VCB

- Printer
  - HP deskjet: 940c, 5550, 5650, 6122
  - HP laserjet: 1200, 1300
  - SONY UP-D21MD
  - SONY UP-D895

Physio Option Parts

Table 13-10 lists the parts of the physio option.

Table 13-10 Physio Option Parts

Description	Part Number	Qty	Reference
Physio module (ECG module)	M2540-62300	1	Table 13-3
Physio USB cable	M2540-69020	1	Table 11-1
Physio trigger cable	M2540-69030	1	Table 11-1

Optional Peripherals

Table 13-11 lists the part numbers of peripheral options available for the M2540A.

Table 13-11 Optional Peripherals

Description	Part Number	Exchange Part Number
NTSC VCR	77616A	77616-68000
PAL VCR	77626A	77626-68000
Black and white printer UPD-895 (USB)	M2540-66700	M2540-66708
Color printer UPD-21MD (USB)	M2540-66800	M2540-66808
MOD drive	M2540-80100	

Supplies and Accessories

Table 13-12 lists supplies and accessories available from Philips for use with the M2540A. To order supplies and accessories, see "Ordering Parts" on page 229. To learn about transducer accessories, please see the *Philips EnVisor Series Transducer Guide*.

NOTE Using any accessory not listed in Table 13-12 may affect electromagnetic emissions or immunity compliance.

Table 13-12 Supplies and Accessories

Description	Quantity	Part Number
Shipping package	1	M2540-87001
Microphone	1	9164-0719
Foot switch	1	M2540-80280
External LAN cable	1	M2540-69080
USB cable 10 ft	1	M2540-69110
MO disk	1	M2540-80101
Floppy disk		9164-0361
S-VHS Tape (SQ-T120)	Case of 10	13921B
Third OEM nounting kit	1	8500-2197-01

Table 13-12 Supplies and Accessories (Continued)

Description	Quantity	Part Number
Paper		
Sony UPP-110S standard paper box	5-roll box	SNY110S
Sony UPP-110 HG glossy paper for SONY UP-D895	5-roll box	SNY110HG
Sony UPP-110 HD high density paper for SONY UP-D895MD	5-roll box	SNY110HD
Sony UPC 21 L color printing pack for SONY UP-D21MD	5-roll box	SNY21L
Ultrasound Gel		
Aquasonic gel, US, 8.5-oz. bottle	12	40483A
Aquasonic gel, US, refill, 5-liter bottle	1	40483B
Ultrasound gel, Europe	12	40404A
Ultrasound gel, Europe, refill, 5-liter bottle	1	40404B
ECG electrodes		
Foam electrodes, rectangular, pre-gelled, 10/card	100 cards	40420A
Foam electrodes, round, pre-gelled, 30/pack	300 packs	40493E
Cloth electrodes, pre-gelled, 5/card	300 cards	13944B
Pediatric electrodes, cloth, pre-gelled, 30/pack	300 packs	13951C
TEE Supplies		
TEE tip protector	24	M2273A
Bite guards	24	M1828A
TEE disinfection basin	1	21110A

Table 13-12 Supplies and Accessories (Continued)

Description	Quantity	Part Number
TEE sheath kit, 12	1	40487A
ECG Lead Sets		
AAMI (North America and Australia)		
3-lead set, grabber		M1603A
3 lead trunk cable		M1500A
3-lead set, snap		M1605A
3-lead set, mini-clip, 1ft 5 in (0.45 m)		M1608A
3-lead set, mini-clip, 2 ft 3 in (1.0 m)		M1609A
IEC Lead Sets (all other countries)		
3 lead trunk cable		M1510A
3-lead set, grabber, 3 ft 3 in (1.0 m) OR use		M1611A
3-lead set, grabber, 3 ft 3 in (1.0 m) ICU use		M1613A
3-lead set, snap		M1615A
3-lead set, mini-clip		M1619A

Table 13-13 CIVCO Biopsy Kits and Sheath Kits

Description	Transducer Used With	CIVCO Part Number
Biopsy kit	21422A (PA4-2)	645-057
Biopsy kit	21422A (CA5-2)	645-069
Biopsy kit	21376A (L1038)	645-067
Biopsy kit	21359A (L7535), 21360A (L5035)	645-059
Biopsy kit	21359A (E6509), 21360A (L5035)	645-039
Biopsy kit	21373B (c5040)	645-032
Biopsy kit	21321A (C3540)	610-588
Biopsy kit	21426A (C5-2)	8500-1178-01
Biopsy kit	L12-3	8500-2229-01
Biopsy kit	C8-4V	M2540-65200
Biopsy bracket	989803002241 (C8-4V), 21437A (C8-4V)	8500-8180-01
Biopsy bracket	989803002251 (L12-5)	8500-9089-02
Sterile transducer cover	989803002241 (C8-4V), 21437A (C8-4V)	610-006
Sterile transducer cover	989803002251 (L12-5), 21426A (C5-2)	610-002
Non-sterile transducer cover	989803002241 (C8-4V)	610-007
Transducer sheath kit		610-833

14 Transducers

Table 14-1 lists the transducers you can use with the M2540A. For biopsy and sheath kits, see "Supplies and Accessories" on page 252.

Table 14-1 Transducers

Description	Model Number	Exchange Part Number	Frequency	Connector*	Rev. ≤ B.0	Rev. B.0
S4 ultraband sector	21330A	21330-68000	4–2 MHz	Standard	X	X
S8 ultraband sector	21350A	21350-68000	8–3 MHz	Standard	X	X
S12	21380A	21380-68000	12–5 MHz	Standard	X	X
c3540 biopsy capable	21321A	21321-68000	5–2 MHz	Standard	X	X
C8-4V endovaginal	989803002241	4000-0960-01	8–4 MHz	Standard	X	X
EC6509 endocavity	21336A	21336-68000	7.5–5 MHz	Standard	X	X
L7535 linear	21359A	21359-68000	10–4.5 MHz	Standard	X	X
L5035 linear	21360A	21360-68000	6.0–2.8 MHz	Standard	X	X
L12-5-50 linear	989803002251	4000-0945-01	12–5 MHz	Standard	X	X
TEE (Omniplane II)	21369A		6–4.6 MHz	Standard	X	X
C5040 curved linear array	21373B	21373-68200	8–3.5 MHz	Standard	X	X
L1038A small parts	21376A	21376-68000	12–5 MHz	Standard	X	X
15-6L intraoperative	21390A	21390-68000	15–6 MHz	Standard	X	X
PA 4-2 sector	21422A	21422-68000	4–2 MHz	Cartridge	X	X
CA 5-2	21425A	21425-68000	5–2 MHz	Cartridge	X	X
D1914c	21221A		2.0 MHz	Pencil	X	X

Table 14-1 Transducers (Continued)

Description	Model Number	Exchange Part Number	Frequency	Connector*	Rev. ≤ B.0	Rev. B.0
C5-2	21426A		5–2 MHz	Cartridge		X
C8-4v	21437A		8–4 MHz	Cartridge		X
L12-3	21475A		12–3 MHz	Cartridge		X
S6-2MPT	21478A		6–4.8 MHz	Standard		X
Tee OmniPlane III	21378A		6–4.8 MHz	Standard		X
5.0 MHz PW/CW	21223B		5.0	Pencil		X
1.9 MHz Transcranial	21228B		1.9	Pencil		X

* Standard = Cannon

Cartridge = AdvanceVision